AMERICAN ENGINEER AND RAILROAD JOURNAL.

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AMERICAN ENGINEER TESTS.

Locomotive Draft Appliances.

VIII.

Report by Professor Goss.

SECTION III.

Methods and Results of Preliminary Investigations.

13. The Preliminary Tests.—It has often been asked whether the draft, as observed from gauges attached to the front end of a locomotive, is in any way affected by changing the point of application of the gauge. The question arises from an appreciation of the intense activity which characterizes the circulation of gases through the front-end. It is evident that, from a theoretical point of view, differences of pressure must exist, for it is in response to these that the flow of the gases is maintained, but whether they are sufficient materially to influence the ordinary forms of draft gauges has, so far as the writer is aware, never been determined. It has not been known whether a gauge attached to the front-end at random can be depended upon to indicate the normal pressure within. The question having frequently been raised, it seemed best, before proceeding with the formal tests, the value of which necessarily depended upon the accuracy with which the draft is measured, to ascertain whether measurable differences of pressure exist, and to secure such information as will permit the selection of a satisfactory point of attachment for the draft gauge. Such an investigation was therefore undertaken under the joint direction of Professor Forsyth and Mr. Reynolds. The conclusions, based on results obtained, are to the effect that, excepting in the immediate vicinity of the exhaust jet, all portions of the front-end between the diaphragm and the front door are substantially at the same pressure. Unless instruments are to be employed having greater accuracy than the ordinary U-tube containing water, it is safe to make the connection for the draft gauge through the shell of the smoke-box at any point which may be most convenient. But connection should not be made behind the diaphragm, for here the pressure varies widely from that in other portions of the front-end. A detailed statement, covering the methods employed in this preliminary work and the results upon which the conclusion stated is based, will not be without interest, and is, therefore, embodied in the remaining paragraphs of this section.

14. Apparatus and Observations.—In investigating the conditions of pressure within the front-end, a considerable number of exploring tubes were employed. These were so fitted that their inner ends could be placed in certain specific positions within the front-end, their outer ends being meanwhile connected with U-tube gauges partially filled with water. The exploring tubes were of ¼-in. pipe. That the pressure within the tubes might not be affected by the motion of the gases in which they were immersed, the inner end of each tube was filled with a plug, and new orifices were formed by drilling a series of holes through the wall of the tube, all as shown by Fig. 10.

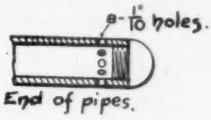


Fig. 10.

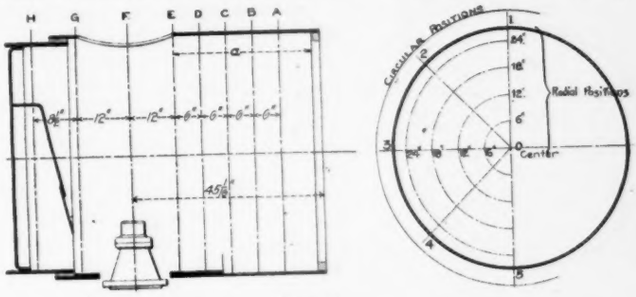


Fig. 11.

As a part of the preparation for the application of the exploring tubes, everything was removed from the front-end excepting the steam pipes, the exhaust pipe and nozzle and the diaphragm, leaving the entire space in front of the nozzle wholly unobstructed. The method followed in applying the exploring tubes to this portion of the front-end, hereafter to be referred to as space a (Fig. 11) may be described as follows: Three exploring pipes, No. 1, No. 2 and No. 3, Fig. 12, were securely fitted within a piece of 1¼-in. pipe, the latter serving as a jacket, by means of which the smaller pipes were handled. The front door of the smoke-box was then drilled and a fitting added, through which the 1¼-in. pipe might be moved in or out, or turned through any desired angle; graduations on the jacket pipe served to indicate the precise position of the tips of the exploring tubes. The inner end of one tube was thus located at the center of the boiler, that of

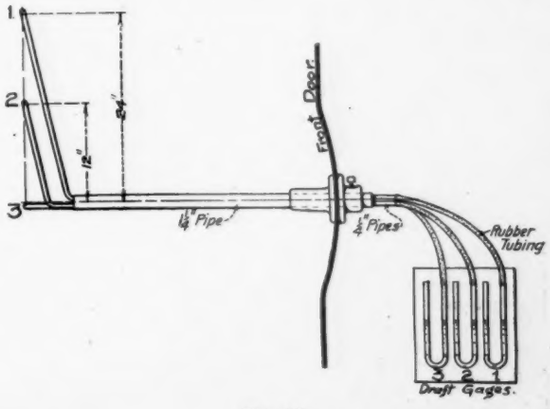


Fig. 12.

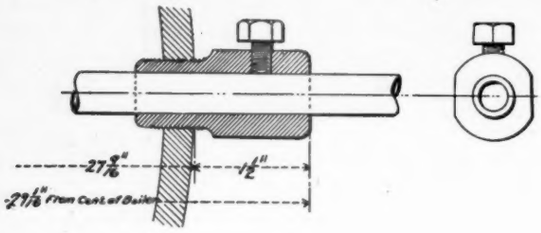
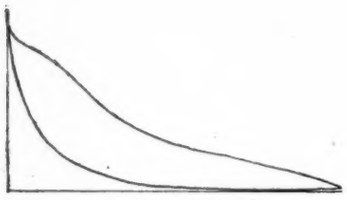
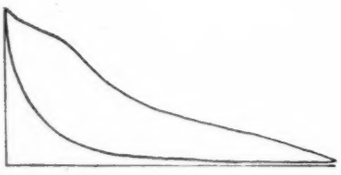


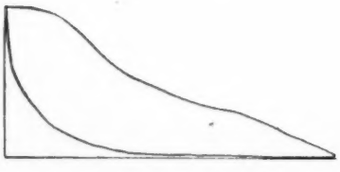
Fig. 13.



40 M. P. H.—194.4 R. P. M.—45.3 Lbs. M E. P.



30 M. P. H.—145.8 R. P. M.—52.3 Lbs. M. E. P.



20 M. P. H.—97.2 R. P. M.—65.9 Lbs. M. E. P.

Indicator Cards One-half Size.

Fig. 14.

another at a radius of 12 ins. from the center, and that of a third at a radius of 24 ins. from the center. Readings were taken on the cross sections A, B, C, D and E (Fig. 11), in the circular positions 1, 2, 3, 4 and 5, and the construction of the apparatus was such as to give readings for the radial positions of 0 in., 12 ins. and 24 ins. from the center. The results thus obtained for speeds of 20, 30 and 40 miles an hour are given in Table I.

Simultaneously with those just described, observations were also made on Sections F, G and H (Fig. 11), Section F being in line with the exhaust pipe, Section G back of the exhaust pipe, but in front of the diaphragm, and Section H back of the diaphragm. The points within the several sections covered (Fig. 11) were: in Section F, positions 2 and 3; in Section G, position 2, and in Section H, positions 3 and 4. For each position of each section there was employed a separate exploring tube, sliding in a fitting similar to that shown by Fig. 13, each tube being graduated to give the location of the inner end, and having its outer end connected by rubber tubing to an individual draft gauge. Readings were obtained from each of these gauges for the radial positions of 6 ins., 12 ins., 18 ins. and 24 ins. Results thus obtained are presented in Table II.

During this preliminary work the locomotive was fitted with the sectional taper stack No. 4 D, and with exhaust pipe No. 1. (See Figs. 2-4, American Engineer, February, 1902, page 35.) The conditions of running were as follows:

Boiler pressure	180 pounds.
Reverse lever, notches from center forward	5
Revolutions per minute for 20-mile test	97.2
Revolutions per minute for 20-mile test	145.8
Revolutions per minute for 40-mile test	194.4

The power which was developed during the tests may be judged from the sample cards which are given as Fig. 14.

The conditions of running specified were maintained as nearly constant as possible for a period sufficiently long to allow the readings of all gauges to be taken. During this period the several exploring tubes were adjusted in rapid succession from one point to another, readings being secured for each position of each pipe. There were employed in this work several different observers, and it was found that five different readings from the thirty-five different points within the smoke-box could be taken in about twelve minutes' time. All work was several times repeated.

It would be too much to assume that under the conditions described there were no variations in conditions. As a matter of fact, there were slight fluctuations both in steam pressure and in speed, and the draft was undoubtedly affected by these changes. The fluctuations, however, were not greater than 2 per cent. in the case of speed, and were much less than this in the case of steam pressure. So that the variation in draft resulting, while doubtless noticeable, could not have been great.

15. Results of Preliminary Tests.—The average values of the draft, measured in inches of water, for each of the thirty-five different points embraced by the investigation, and for speeds of 20, 30 and 40 miles, are presented in Tables I. and II.

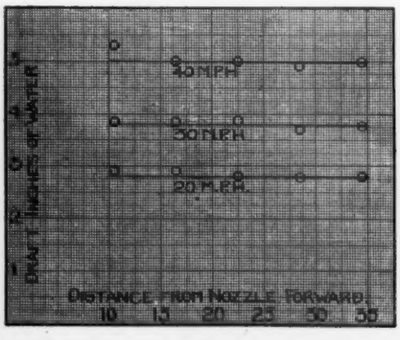


Fig. 16.

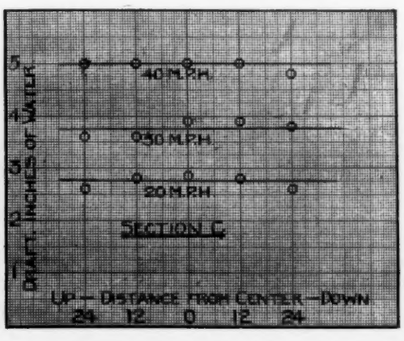


Fig. 17.

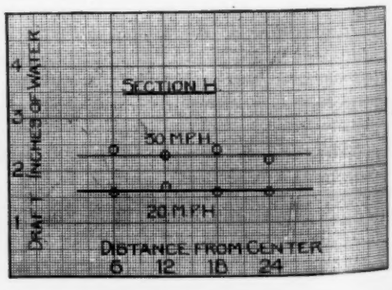


Fig. 18.

TABLE I. Draft in Inches of Water.

Readings in Space a.

Circular Position.	Section.	A.			B.			C.			D.			E.		
	No. of Pipe.	1.	2.	3.	1.	2.	3.	1.	2.	3.	1.	2.	3.	1.	2.	3.
1.	20 m.p.h.	2.6	2.7	2.9	2.6	2.9	2.9	2.6	2.8	2.8	2.6	3.0	2.8	2.7	2.6	2.8
	30 "	3.5	3.6	3.8	3.8	3.9	3.9	3.6	3.6	3.8	3.6	3.6	3.6	3.6	3.7	3.6
	40 "	5.3	5.3	5.4	5.2	5.3	5.2	5.0	5.0	5.0	4.9	5.0	5.0	5.0	5.0	5.0
2.	20 "	2.7	3.0	3.1	2.7	2.8	2.8	2.6	2.6	2.7	2.6	2.8	2.8	2.7	2.7	2.8
	30 "	3.7	3.7	3.8	3.7	3.7	3.9	3.7	3.7	3.8	3.5	3.5	3.5	3.5	3.6	3.7
	40 "	5.3	5.4	5.4	5.0	5.0	5.0	5.0	5.1	5.1	5.0	5.0	4.9	4.9	5.0	5.0
3.	20 "	2.7	3.0	2.9	2.9	2.9	2.9	2.8	2.9	2.8	2.6	2.7	2.8	2.7	2.7	2.7
	30 "	3.7	3.7	3.9	3.7	3.8	3.8	3.7	3.9	3.9	3.4	3.5	3.6	3.7	3.8	3.9
	40 "	5.2	5.3	5.3	4.8	4.8	4.9	5.1	5.1	5.1	4.8	4.9	4.9	4.9	5.0	5.0
4.	20 "	2.7	2.9	2.9	2.8	2.8	2.9	2.8	2.8	2.8	2.7	2.9	2.9	2.7	2.8	2.8
	30 "	3.8	3.9	3.9	3.8	3.8	3.9	3.9	3.9	3.9	3.7	3.8	4.0	3.6	3.7	3.9
	40 "	5.3	5.3	5.3	4.9	5.0	5.0	5.0	5.1	5.0	4.8	5.0	4.9	4.8	5.0	5.0
5.	20 "	2.9	2.8	2.8	2.7	2.9	3.0	2.6	2.8	2.8	2.6	2.7	2.7	2.6	2.7	2.8
	30 "	3.7	3.8	3.8	3.7	3.7	3.7	3.8	3.9	4.0	3.7	3.9	3.9			
	40 "	5.3	5.3	5.2	5.1	5.2	5.0	4.8	5.0	5.0	4.7	4.9	4.9	4.7	5.0	5.1

TABLE II. Draft in Inches of Water.

Readings in Sections F, G and H.

Section.	F.								G.				H.							
Circular Position.	2.				3.				2.				3.				4.			
Radial Position.	1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.
20 m.p.h.	3.4	2.7	2.8	2.7	2.8	2.8	1.7	2.7	2.7	2.8	2.5	2.5	1.6	1.7	1.6	1.6	1.6	1.8	1.7	1.8
30 "	4.7	4.1	3.6	3.6	4.7	4.0	3.8	3.5	3.4	3.6	3.5	3.4	2.4	2.3	2.4	2.2	2.3	2.4	2.4	2.4
40 "	5.0	5.0	4.8	4.7	5.1	5.0	4.8	4.7	5.0	4.4	4.7	4.8	3.0	2.5	2.5	2.7	2.8	3.1	2.8	3.2

A study of these data will show that for a given speed all points in front of the diaphragm have almost the same pressure. Variations recorded are generally not greater than 0.1 of an inch, which, under the vibrating conditions of the laboratory, is the limit of accuracy to which draft gauges can be read. Where differences are greater than 0.1 of an inch, they are probably due to accidental causes, since a careful study of them fails to disclose any law which can serve to explain them. A few comparisons will serve to show the general character of the results. For example, the values obtained for the several points between the exhaust pipe and the front door, along the axis of the smoke-box (center position, Sections A, B, C, D and E, Fig. 11), are presented in Fig. 15. With one exception, no point on the diagram varies from the assumed normal draft by more than 3 per cent. The one exception applies to that point in the smoke-box which is but 12 ins. distant from the center of the nozzle. With the low nozzle used, and with allowance for the spread of the jet, this point was not far removed from the edge of the stream of exhaust steam. Notwithstanding this fact, the diagram (Fig. 15) shows that for speeds of 20 and 30 miles the draft is normal at this point. It is only when the power of the engine is made to approach its maximum, as is the case when the speed is increased to 40 miles, that the condition of pressure at the point in question is influenced by the jet.

Again, a comparison of the pressure at several points along a vertical diameter of the smoke-box (Section C, radial positions 6 inches and 18 inches, and circular positions 1 and 5, Fig. 11), is presented by Fig. 16. In this diagram there is one value which departs from the normal value of the group to which it belongs by an amount equal to 0.2 of an inch. There are others showing variations as great as 0.15, the largest percentage difference for the whole diagram being approximately six. Other groups of results have been plotted, but those which are presented are typical of all. They justify the conclusion that while different points in the smoke-box show differences in pressure which are clearly distinguishable, the value of such differences is so slight that it does not seem necessary to take them into account in fixing the location of the draft gauge, except in so far as it indicates that the point of application should not be too near the steam jet. In accord with this view, it was decided that the permanent location of the draft gauge, in the case of the Purdue locomotive, to serve on all future work, might be on a horizontal diameter of the boiler in line with the nozzle at a point quite near the outer shell, or, stating the location more specifically by the aid of Fig. 11, in Section F, circular position 3, radial position 24.

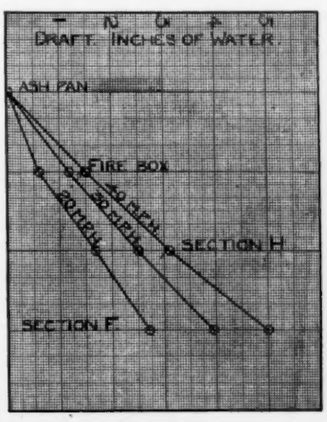


Fig.. 18

The preceding statement concerning the uniformity of pressure within the smoke-box applies to all that portion between the diaphragm, or baffle plate, and the front door. It does not apply to the space behind the diaphragm. In this space the draft is always less than in the main portion of the front-end. How much less will be seen by comparing the values presented in Table II., Sections F and G of the table being in front of the diaphragm and Section H behind the diaphragm. It is worthy of note that the pressure within the space behind the diaphragm is subject to the same degree of uniformity as other portions of the front-end, but as it is an intermediate point, it is evidently not well to employ it as a point of application for the draft gauge.

16. Distribution of Draft.—While the present investigation was designed to concern smoke-box conditions only, it will be of interest to note in what manner the difference of pressure between the smoke-box and the atmosphere is utilized in moving the stream of air and gases against the resistances set in their path. A study of this question was, therefore, made a part of the preliminary tests. The results show that approximately one-third of the total draft is required to move the air from the ashpan into the furnace, another third from the furnace through the tubes, and the remaining third from

the front tube-sheet under the diaphragm and into the main portion of the front-end. A concise statement of the facts is shown by Table III., and a graphical view is shown by Fig. 18.

TABLE III.

Percentage of Total Draft Required.

Speed M.P.H.	To draw air into fire-box.	To draw smoke and gases through flues.	To draw smoke and gases under diaphragm.
20	22.6	41.1	36.3
30	30.1	33.6	36.3
40	30.4	32.0	37.6

The degree of vacuum within the firebox was obtained by connecting a draft gauge with a hollow staybolt. The values for all other points were obtained by means already described. They appear in Tables I. and II.

The statement that the diaphragm offers as much resistance to the forward movement of the air as the tubes, and absorbs approximately one-third of the total draft effect, is too significant to be passed without further comment. It should be noted, therefore, that the adjustable portion of the diaphragm in question was raised to the highest point for which, in the design of the engine, provision had been made. The distance between the lower edge of the diaphragm and the bottom of the smoke-box was 14 inches, and the area of opening under the diaphragm amounted to 430 square inches, or about 83½ per cent. of the total tube area.

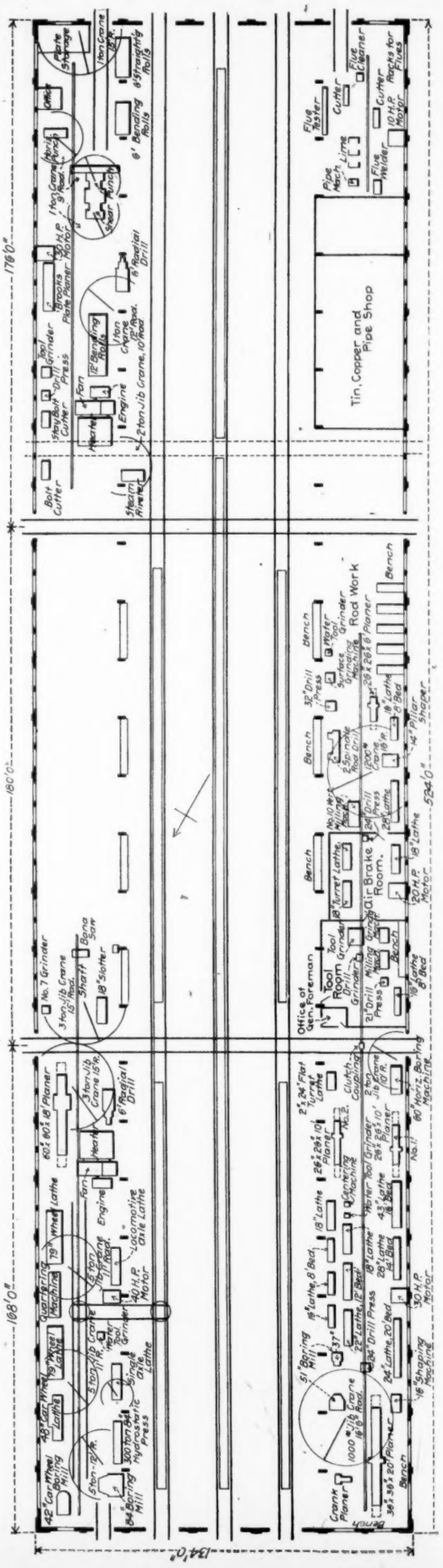
Typographical Errors.

In the February issue, page 35, the diameter of the exhaust tip of the Purdue engine is given as 4½ ins. It should have been 4¼ ins. Also, in the March issue, page 68, in referring to the practice of Purdue in selecting a location for the draft gauge, it was said, "In work previously carried on at Purdue the draft has been obtained by means of a U-tube connecting with a pipe extending into the smokebox just *back* of the diaphragm." It should have been, "In work previously done on *Schenectady No.* 2 the draft gauge has been connected with a pipe extending into the smokebox in *front* of the diaphragm."

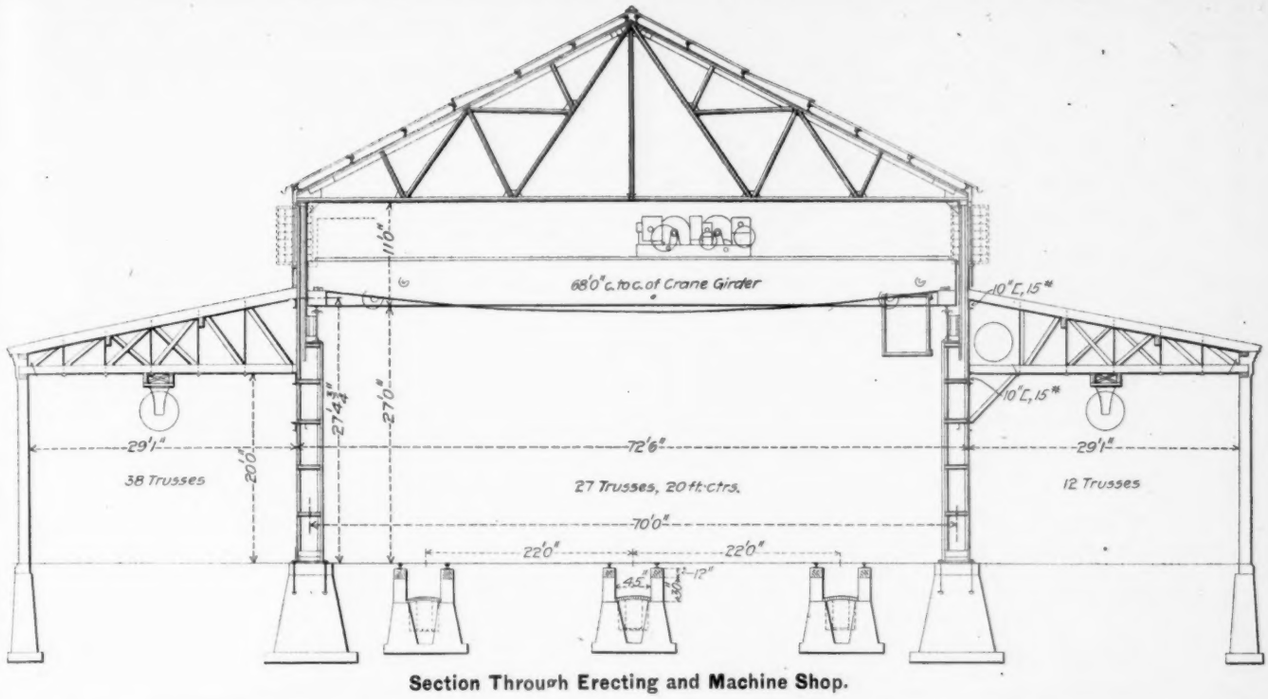
(To be continued.)

OIL FUEL AS A LABOR SAVER.

On many of the large engines now in use on our railways, hauling very heavy trains, over level divisions, the physical endurance of the fireman has been about reached, and with the return of the summer months his staying powers will be even more heavily taxed. In this connection the recent performance of S.S. "Murex," from Singapore to London, via Cape Horn, is of exceptional interest. This vessel made that long voyage with crude petroleum as fuel, and showed an estimated saving of about seven tons per day over Welsh coal, which is of good quality. The "Murex" made the voyage with three stokers instead of twenty-four. In locomotive practice such economy of labor is not possible, but the use of oil fuel would at least remove the necessity of supplying two firemen for one division, which some roads have found it desirable to provide. At sea, the economy of oil as fuel has also the advantage of reducing the space occupied for any given voyage, and this reduction provides more room for what is called on railways "revenue load." On land transportation, this economical advantage might possibly take the form of greater mileage made with one tender full of oil than could be made with coal; or the reduction of wear and tear on tenders by reason of the less weight carried for a single trip; together with the absence of the work of fire cleaning, and ashes to be handled at terminals. When the limit of physical endurance of the railroad fireman has been fully reached, oil as fuel, or the mechanical stoker, are the obvious solutions of the problem.



Floor Plan of Locomotive Erecting, Boiler and Machine Shop.
NEW SHOPS AT DU BOIS, PA.—BUFFALO, ROCHESTER & PITTSBURGH RAILWAY.



Section Through Erecting and Machine Shop.

NEW SHOPS AT DU BOIS, PENNSYLVANIA.

Buffalo, Rochester & Pittsburgh Railway.

Details of the Plant.

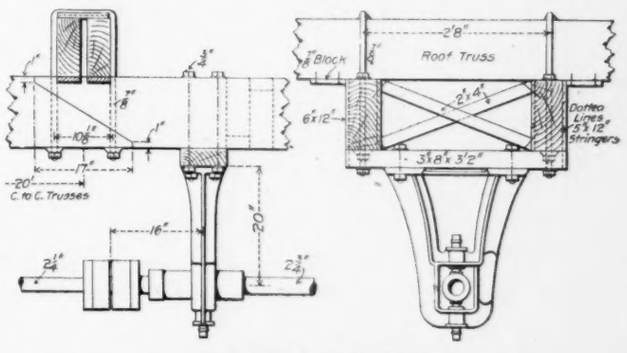
On page 107 of our April number will be found a description of the ground plan of these shops. The accompanying engravings illustrate the most important details, with particular reference to the locomotive shop, power house and roundhouse.

The buildings are of brick, with slate roofs. The roof trusses of the erecting-shop, power house and roundhouse are of steel, and those of the machine bays of wood, as shown in the cross-section of that shop. The blacksmith shop, store and oil houses have wooden roof trusses. Those of the blacksmith shop are of 80-ft. span and are spaced to 20-ft. centers, with 20-ft. clear head room. This building has a continuous ventilator, 9 ft. wide, on the roof.

The storehouse has two stories, with 10 ft. 10 ins. head room in each, and wooden roof trusses at 20-ft. centers. This building has a 4,000-lb. electric elevator. The first floor of the oil house has a clear head room of 12 ft. 10 ins. This floor is 4 ft. above the tracks. There is an 8-ft. basement. The building is divided into two sections by means of a 12-in. fire wall. One section is used as a distributing room, and contains shelving for the storing of portable equipment removed from engines. The other section is used for storing oil and waste. The basement contains the tanks. The oil flows from the large tanks to smaller tanks through a check valve, these smaller tanks then being emptied by air pressure. There is no pressure on the large tanks. In the room above are kept the waste and barreled oil.

The power house has brick walls 13 ins. thick, with 17-in. pilasters. It is divided by a 12-in. brick wall into two portions, the boiler room occupying 37 ft. and the engine room 54 ft. A basement under the engine room provides for the piping, pumps and electric cables, and this building is connected through the locomotive shop to the roundhouse by a 5 x 4-ft. 7-in. brick and concrete subway, which is drained to a sump at the roundhouse end. A plan of the blacksmith shop is shown, in which the equipment is indicated. It has downdraft forges connected under ground to the exhaust fan. It also has three forges 6 ft. in diameter, ten other forges and two heating furnaces. It has four jib cranes for general use, besides two 1-ton cranes at the punch and shears. Power is furnished by a 40-n.p. motor, belted to a single transverse line shaft. In this drawing the frog and switch shop is shown at the lower left-hand corner. A 50-lb. hammer and a 28-in. drill press are provided for the toolmakers. Flanging for the boiler shop will be done here by aid of a flanging clamp worked by compressed air. In this way the boiler shop is kept free from all but portable fires.

In the boiler room of the power house are four Stirling boilers of 200-h.p. each. Coal is received on a trestle beside the boiler room and is delivered through the wall by gravity. In the engine room are two 100-h.p. and one 200-h.p. Westinghouse engines and the air compressor. The pipe subway to the locomotive shop contains a 12-in. exhaust pipe, a 6-in. live steam main, a 4-in. hot water pipe, a 4-in. air pipe, 4-in. return piping and the electric cables. The piping plan is very compact. It includes a feed water heater of 1,000-h.p. capacity and the piping. With the exception of the drop at the power house into

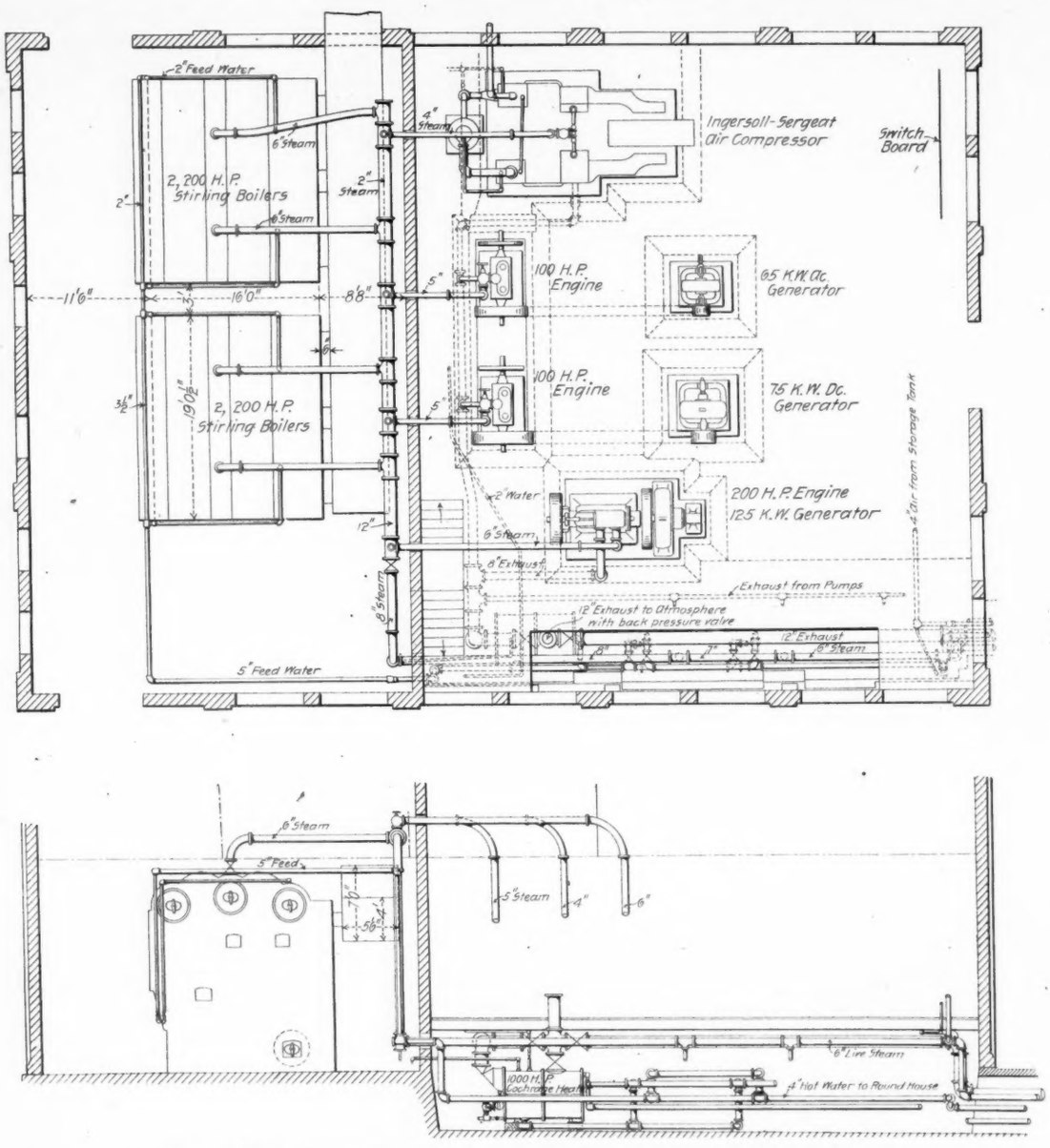


Attachment of Shafting.

the subway it is perfectly straight. It is fitted with Wainwright expansion joints.

For draft on the boiler a 120-ft. round brick stack is provided. It is constructed on a 14-ft. 6-in. square concrete foundation and has an outside diameter of 14 ft. 6 ins. at the base, tapering to 9 ft. 4 ins. at the top. The flue is 6 ft. 6 ins. in diameter. The batter of the outside is ¼ in. in 12 ins.

At present the roundhouse has 16 stalls. Its roof trusses



Plan of Power House, Du Bois Shops.—Buffalo, Rochester & Pittsburg Railway.

are of steel, with a 77-ft. span and no intermediate posts. In the plan the heating conduit is shown. It is under the floor and delivers hot air to the pits through drain tile conduits. Air is delivered at two points in each pit, and is so arranged that it will be discharged under the running gear of the engine as well as the tender. The building is lighted by eighty 16-c.p. incandescent lamps run in rows of six, each row controlled by a snap switch. In addition there are twenty-six wall receptacles for extension cords, to permit carrying lights under the engine, and doing away with the smoky torch. Hot and cold water are piped between the pits under the floor, steam and air being brought along the roof trusses.

The turntable, 70 ft. in diameter, is operated by a Westinghouse turntable "donkey," consisting of a series reversible 10-h.p. motor mounted within a cast-iron frame having a traction wheel which runs upon the rail of the turntable pit.. The roundhouse floor is of brick, and those of the erecting and machine shops are concrete.

In connection with the locomotive shop no statement was made last month with reference to the size of the boiler shop. This is now given in terms of proportion and, for convenience in comparison, the proportion in other well-known shops is included:

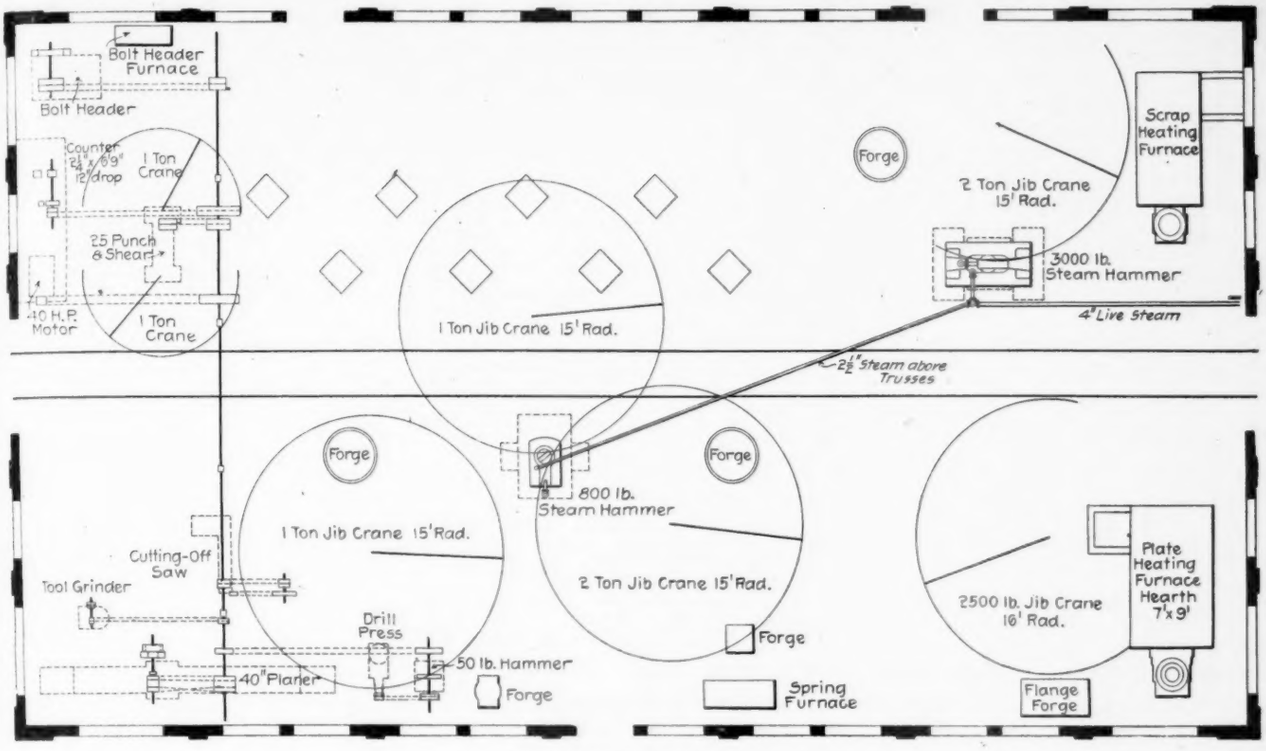
	Per cent. of Machine and erecting shop.	Total. Boiler shop.
Du Bois—170 ft. long	67	33
West Burlington—C., B. & Q.	78	22
Roanoke—Norfolk & Western	77	23
Concord—B. & M. R. R. (if full width)	74	26
Denver—Colorado & Southern	75	25
Oelwein	76	24

There are three tracks through the locomotive shop, the central having a pit its entire length, interrupted only by the pipe conduit, which extends across the shop to the roundhouse. At the south end the other two tracks, for a length of 170 ft., have no pits; they are used for boiler work. For delivery of material two standard gauge tracks cross the shop, dividing it into three nearly equal portions.

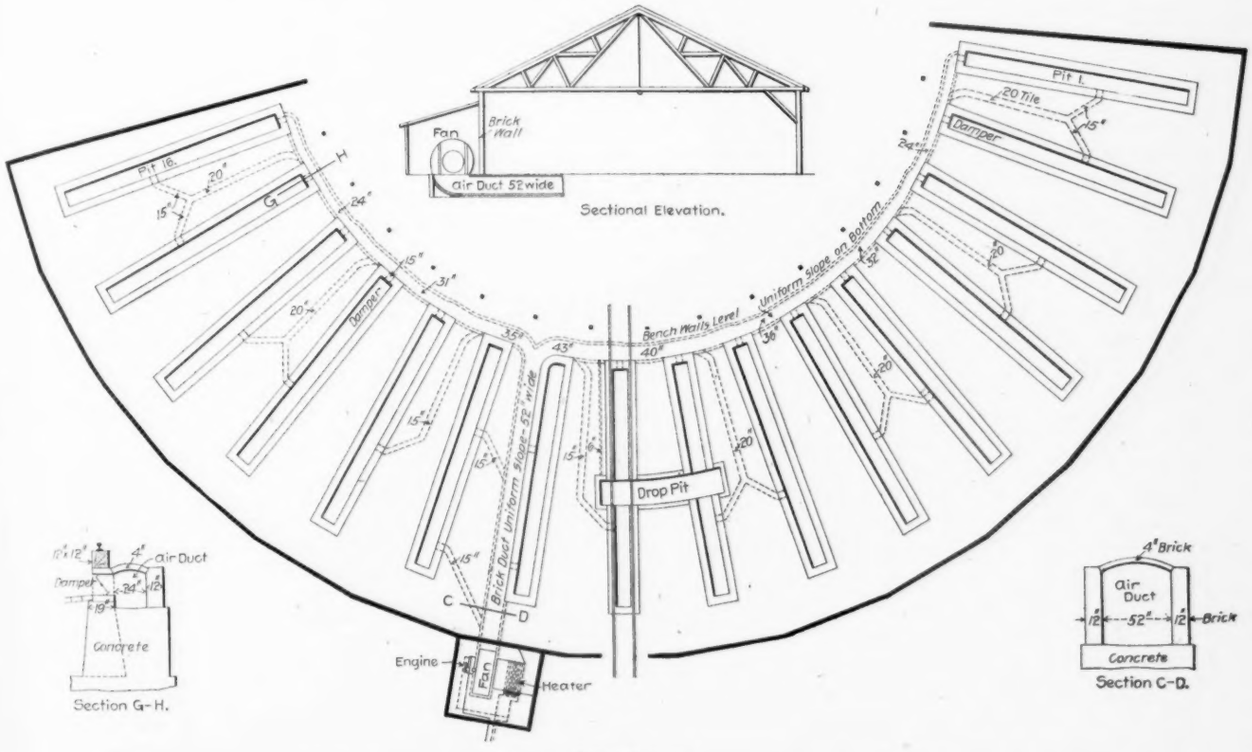
The machine shop is divided into two bays, having a number of small jib cranes. On the east side the central portion is now used for light woodwork, and may be used for increasing the machine shop capacity when required.

Natural lighting is provided through skylights at 20-ft. centers over the machine bays, and in the roof of the erecting shop is an 8-ft. continuous skylight on each side.

The heating of the locomotive shop is by the fan system with overhead conduits. It is worked ordinarily with exhaust steam and is piped for live steam also. It is guaranteed to



Plan of Blacksmith Shop.



Roundhouse.

DU BOIS SHOPS.—BUFFALO, ROCHESTER & PITTSBURGH RAILWAY.

heat the building to 65°, with an outside temperature of 15° below zero.

The lighting of the locomotive shop is by three rows of arc lamps, nine in each row, at 60-ft. centers. One of these is at the center of the building and the others are under the crane runways. Each machine and bench has one or more 16-candle incandescent lamps. There are two plug receptacles for extension cords on each of the columns, also in the center pit; approximately every 15 ft. there is a junction box containing a socket and plug receptacle.

The shop is driven on the group system with line shafts attached to the roof trusses of the machine bays. The detail of this attachment is shown in one of the engravings. The shafting stringers are put up without boring holes in the roof trusses, U bolts being used for the attachment. The line shafts are cold-rolled and are carried on Hyatt roller bearings,

and a shaft 200 ft. long, without belts, could be turned by the hand.

Electrical Apparatus.

There are three generators in the power house. The 200-h.p. engine drives a 125-kw. direct-current 250-volt generator for power and day lighting. The night unit is a 75-kw. direct-current 250-volt generator driven by a 100-h.p. engine, and the yard and distant lighting is furnished by a 65-kw. alternating two-phase generator, giving 2,200 volts and 7,200 alternations. The yards are lighted for three miles by lamps placed 400 ft. apart. The outside arc lighting consists of three circuits of Manhattan alternating current series enclosed long-burning arc lamps of 25 lamps each, and one circuit to the Falls Creek station; this station is wired for incandescent lamps, and is fed through a Westinghouse transformer; this main circuit runs south, also connects through transformers to 104-volt secondary circuits, and furnishes lights for the Du Bois passenger station, freight station and Y. M. C. A. building, and the Du Bois car repair shops. Each of these outside arc circuits is connected in series with a Manhattan series alternating current voltage regulator. These regulators being automatic in their action, the going out or the short circuiting of a lamp or a group of lamps will make no appreciable difference to the balance of the circuit, as the excessive current is taken up in the regulator choke coils.

The engine room switchboard is of the Westinghouse type, of white Italian marble, 28 ft. long by 8 ft. high. The north panels of the board contain the apparatus to control the alternating current machine, and plunger switches of the Westinghouse pattern, one switch for each of the phases, each leg in each phase being fused on the back of the board. The fuses are the porcelain tubular enclosed type. The south panels contain the ammeters, voltmeters and main circuit switches for the motor circuits, and are fed from the 125-kw. generator through the basement. The center panels are for the 75-kw. machine and the lighting apparatus. The switchboard is wired on the back with two sets of bus-bars for the direct-current circuits, one set for the lighting and one set for the motors, and is so arranged that either machine may be operated on either lights or power, or both machines on either light or power. This makes the plant absolutely interchangeable, and is very desirable on account of its flexibility.

Five motors drive the machine shops. The largest, 40-h.p., drives the heavy tools, including the wheel work at the northeast end. A 30-h.p. motor drives the group at the northwest corner. The tool and air brake rooms and the rod work are driven by a 20-h.p. motor in the air brake room. A 10-h.p. motor drives the flue machinery, and on the opposite side of the shop the boiler machinery has a 30-h.p. motor. These motors are installed on platforms elevated about 5 ft. from the floor. A 40-h.p. motor in the blacksmith shop and another of 10-h.p. for the roundhouse turntable and a 7½-h.p. motor for the flue rattler complete this equipment.

The wiring for the lighting and motor circuits provides for growth of the plant, and has a 50 per cent. overload capacity. It is all underground in the main conduit and boxes leading from it. At the east side of the locomotive shop is the distributing box. It has three panels with three sets of feeders. One of the panels feeds the cranes. The center panel controls the 30 and 40-h.p. motors on the east side of the building, and the 7½-h.p. motor for the flue rattler. The third panel controls the arc and incandescent lighting for the east side of the building, feeding 10 branch circuits for incandescent lights. Each circuit has about 20 16-candle power 230-volt lamps. The arc circuits are controlled at this point by a single switch, and each arc lamp is controlled by a separate switch. The other panel board is placed on the west wall of the shop. In the blacksmith shop are three circuits for incandescent lamps and eight long burning arc lamps.

The electrical equipment was supplied by the Westinghouse Electric & Manufacturing Company. The cranes were supplied by Manning, Maxwell & Moore; the machine tools by the Niles-Bement-Pond Company, of New York, and the Hilles & Jones Company, of Wilmington, Del. The steel work of the buildings was furnished by the American Bridge Company; the brick work by Hiram Edgerton, of Rochester, N. Y.; the piping by Howe & Bassett, of Rochester, N. Y.; the electric wiring by Higgins-Almstead Co., of Rochester; the nineteen pneumatic and hand-operated jib cranes by the Whiting Foundry Equipment Co., of Chicago; the heating apparatus and forges by the Buffalo Forge Co. The tool and machinery list is presented in unusual detail as follows:

TOOL LIST.

WHEEL AND AXLE MACHINERY.

Two 79-in. Niles driving wheel lathes.
One Niles quartering machine.
One Schaffer 79-in. wheel press, 300-ton triple pump.
One Niles locomotive axle lathe, 13 ft. bed, with 2 carriages.
One Pond single axle lathe, 7 ft. 6 in. between centers.
One 48-in. Niles steel tired car wheel lathe.
One 42-in. Pond wheel borer, with automatic hub facer.

PLANERS.

One 24-in. Bement crank planer.
One Niles 36 in. x 36 in. x 20 ft. planer, 2 heads on cross rail.
Two Niles 26 in. x 26 in. x 16 ft. planers, 1 head on cross rail.
One Niles 26 in. x 26 in. x 6 ft. planer, 1 head on cross rail.
One 60 in. x 60 in. x 29 ft. 3 in. Niles planer, 2 heads on cross rail.
One Pittsburg Machine Tool Co. 40 in. x 16 ft. frog and switch planer.

LATHES.

One 44-in. Bement lathe.
One 24 in. x 20 ft. Niles standard engine lathe.
Three 18 in. x 10 ft. LeBlond engine lathes.
Four 16 in. x 8 ft. LeBlond engine lathes.
Two 18 in. x 6 ft. No. 2 American improved turret lathes.
One Jones & Lamson 2 in x 24 in. flat turret lathe.
Two 28 in. x 14 ft. 6 in. back geared Pond engine lathes.
Two 22 in. x 12 ft. Niles engine lathes.
One 16 in. x 8 ft. LeBlond engine lathe.

SLOTTERS.

One 18-in. Bement slotting machine.

SHAPERS.

One 16-in. Bement single traveling head shaper, 72-in. bed.
One 14-in. Pratt & Whitney pillar shaper.

MILLING MACHINES.

One Bement No. 10 vertical milling machine.
One No. 2 LeBlond universal milling machine.

BORING MACHINES.

One Niles No. 2½ horizontal boring and drilling machine.
One 84-in. Niles vertical boring and turning mill, 2 heads.
One 51-in. Niles vertical boring and turning mill, 2 heads.
One 37in. Niles vertical boring and turning mill, 2 heads.
One Bement No. 7 two-spindle connection rod drilling machine.

DRILL PRESSES.

One 32-in. Aurora drill press.
Two 28-in. Aurora drill presses.
Two 24-in. Aurora drill presses.
Two 6-ft. Pond radial drills.
One 21-in. Aurora drill press.

GRINDING MACHINES.

One No. 3 universal grinder. (Universal Machine Co.)
One Gisholt universal tool grinder for lathe and planer tools.
Four Whitney No. 2 water tool grinders, single wheel.
One No. 1 Washburn C twist drill grinder.
One Diamond No. 7 grinding machine for 20-in. wheels.
One Diamond surface grinder, with 28 in. x 64 in. table.
One Pratt & Whitney No. 1 centering machine.

BOLT AND PIPE MACHINERY.

Two No. 7 Jarecki pipe threading machines.
One Acme No. 1 ½-bolt header.
One Acme 2-in. double bolt cutter; Class A.

BOILER SHOP AND BLACKSMITH SHOP.

Two Hilles & Jones combined punches and shears. One 48-in. throat for 1-in. plate. One 25-in. throat for 1-in. plate.
One Hilles & Jones horizontal punch.
One set No. 5 Hilles & Jones power bending rolls for ¾ plate 12 ft. wide.
One set No. 0 Hilles & Jones power bending rolls.
One set Hilles & Jones power plate straightening rolls.
One 18-ft. plate planer.
One Baird staybolt nipper, to cut 1¼-in. bolts.
One Allen 24-in. air riveting machine for 1-in. rivets.
One Bement steam riveting machine, 9-ft. stake, 36-in. cylinder, for 1-in. rivets.
One Bement 3,000-lb. double frame steam hammer.
One Bement 800-lb. single frame steam hammer.
One Scranton 50-lb. dead stroke hammer.
One Newton No. 2 combination power cutting off saw.
One Otto flue cleaner.
One Hartz flue welding machine.
One Ferguson flue welding furnace.
One pair 12-ft. flanging clamps, air operated.
One pair 9-ft. flanging clamps, hand operated.

One spring forming machine.
Two Acme tube rolling and cutting out machines.
One Clement 48-in. band saw.
One Greenlee Bros. No. 6-B heavy pattern single spindle radial vertical right hand boring machine.

POWER HOUSE.

Four 202-h.p. Stirling boilers.
One Westinghouse 14 and 24 by 14 compound engine.
Two Westinghouse 12 by 11 standard engines.
One Ingersoll & Sergeant air compressor, rated capacity 950 cubic ft.
One 1,000-h.p. cylindrical horizontal Cochrane feed water heater and receiver.
Two Worthington general service piston pumps, having steam cylinders 10-in. diameter by 10-in. stroke.
One Worthington packed plunger pump, having steam cylinders 16-in. diameter by 10-in. stroke, and brass mounted water cylinders 10¼-in. diameter by 10-in. stroke. Capacity, 42,000 gallons per hour.
Two Worthington 3 x 2 x 3 packed piston Class 3 pumps with metal valves.

ELECTRICAL APPARATUS.

One Westinghouse 125 k.w., 250-volt, 280 r.p.m. compound wound "engine type" generator.
One 75 k.w., 250-volt, 750 r.p.m. multipolar belt driven generator.
One 65 k.w., 2,200-volt, 7,200 alternations, 2 phase alternating current generator, operating at 900 r.p.m.
One 2½-h.p. direct current multipolar exciter, operating at 125 volts, 1,800 r.p.m.
Two 40-h.p., 220-volt, shunt wound multipolar motors, operating at 550 r.p.m.
Two 30-h.p., 220-volt, shunt wound multipolar motors, operating at 575 r.p.m.
One 20-h.p., 220-volt, shunt wound multipolar motor, operating at 600 r.p.m.
One 10-h.p., 220-volt, shunt wound multipolar motor, operating at 750 r.p.m.
One 7½-h.p., 220-volt, shunt wound multipolar motor, operating at 850 r.p.m.

CRANES.

Two "Shaw" 50-ton electric traveling cranes, each with 6-ton auxiliary hoist; span 68 ft. center to center of runways; top of runway 27 ft. above floor; speed, main hoist, 6 ft. per minute, loaded; auxiliary hoist, 60 ft. per minute, light; speed of trolley, 100 feet per minute, loaded; speed of bridge, 250 ft. per minute, light; line voltage at crane, 220 volts; length of runway, 521 ft. 2 in.

FAST RUNS ON THE PENNSYLVANIA.

From official sources we have obtained the following record of fast runs by special trains carrying President Cassatt from Philadelphia to Jersey City, March 23 and 24, 1902:

Miles.	Station.	Extra No. 804 Sunday, March 23, 1902.	Speed between stations. Miles per hour.	Extra No. 850, Monday, March 24, 1902.	Speed between stations. Miles per hour.
....	Broad Street	1.12 P. M.	....	12.19 P. M.	....
2.7	Mantua	.....	29.5	.....	32.4
5.4	Germantown Junc..	.....	54.0	.....	54.0
9.2	Frankford Junc....	.....	57.0	.....	65.1
13.2	Holmesburg Junc..	.....	80.0	.....	87.3
23.4	Bristol	.....	68.0	.....	74.2
33.7	Trenton	.....	77.2	.....	72.7
43.4	Princeton Junc....	.....	72.7	.....	83.1
49.4	Monmouth Junc...	.....	90.0	.....	72.0
57.5	Millstone Junc....	.....	60.7	.....	72.0
64.6	Metuchen	.....	71.0	.....	81.1
70.4	Perth Amboy Junc.	.....	81.9	.....	73.3
75.7	South Elizabeth...	.....	85.0	.....	67.0
79.4	Waverly	.....	74.0	.....	59.2
82.4	East Newark Junc.	.....	45.0	.....	48.0
89.4	Jersey City	2.32 P. M.	70.0	1.38 P. M.	60.0
		80 minutes.	Average speed per hour, 67.1 miles.	79 minutes.	Average speed per hour, 67.9 miles.

In connection with the recent celebration of the Baldwin Locomotive Works an interesting comparison was prepared to show the advance which has been made since 1870. At that time the average number of men per locomotive built in the year was 6.51. The average pay was $11.66 per week; the average tractive power per locomotive, 10,461 lbs.; the average horse-power per locomotive, at ten miles per hour (working full stroke), 279; the average horse-power represented by the work of one man per year, 42.85, and the average number of men employed in that year 1,822. In the year 1901, with much heavier and more powerful engines, the average pay per week, $13; average tractive power per engine, 26,965 lbs.; average horse-power at ten miles per hour, 719; average horse-power represented by one man, 106.51, and average total number of men employed 9,281. This is an increase of nearly 250 per cent. in the average horse-power represented by one man's work.

SUPERHEATED STEAM FOR LOCOMOTIVES.

Results of Trials on the Prussian State Railways.

The issues of the "Zeitschrift des Vereins Deutscher Ingenieuren" (Journal of the Association of German Engineers) for February 1 and 8 contain an interesting paper on the economies and advantages to be obtained by the use of highly superheated steam on locomotives. The paper is by Privy-Councillor Garbe, one of the Board of Managing Directors of the Prussian State Railways, and was read before the Berlin center of the Association of German Engineers. By title the paper is a report on the locomotives exhibited at Paris, but Herr Garbe found the locomotives with the Schmidt superheater so interesting that the greater part of his report is devoted to locomotives of this class.

The superheater consists of about 63 tubes 1.3 inches inside diameter, fitted round the inside of the smoke box wall. The steam to the cylinders passes through these tubes while the furnace gases pass round outside of them. The steam is delivered to the cylinders at a temperature of about 825 degrees F., that is, superheated 450 degrees F. at 170 pounds per square inch boiler pressure.

Four locomotives with this superheater are in use on the Prussian State Railways, and as a result of the economies they have shown twenty-five new engines now building are to be similarly equipped. The first engine equipped with the superheater has been in service for two years without any trouble developing in the superheater or in the cylinders. Herr Garbe reports that in October, 1901, this engine, which is of the American four-coupled type, was tested against two compound locomotives with the following favorable result:

	Per Train Mile. Water.	Coal.
Superheater No. 71	206 lbs.	34.0 lbs.
Compound No. 73	278 "	37.7 "
Compound No. 49	278 "	38.2 "

These results are the averages from a trial of nine days' running express trains of an average total weight of 360 gross tons. The engine from which these figures were taken has cylinders 19⅜ x 23⅝ ins. and driving wheels 78 ins. in diameter. Herr Garbe's paper is profusely illustrated with indicator diagrams and he calls particular attention to the cards taken with partially closed and short cut off. It is in the ability of the locomotive with the superheater to run economically under such conditions, that Herr Garbe finds one great advantage of the superheater. The range of power which is economically available with superheated steam is so great, that Herr Garbe proposes to build his locomotives with large cylinders and to run them under ordinary conditions throttled down and with a short cut-off; the reserve cylinder power available will then be sufficient to render unnecessary the present practice of double heading trains on heavy divisions.

According to Herr Garbe's estimates the entire work on the Prussian State Railways can be handled with four classes of locomotives if these are fitted with superheaters. He has taken up the question with representatives of the four most prominent German locomotive builders, and in connection with them has determined the proportions of these four standard types. Drawings of these engines are given with the original paper. The engines proposed are the following:

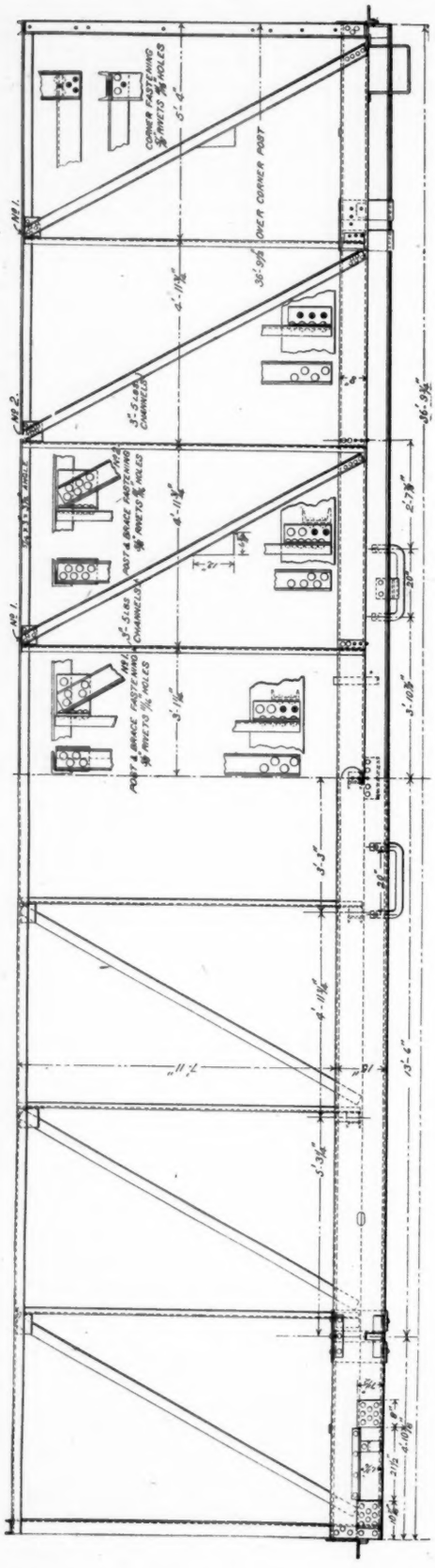
Eight-wheeled American type for express service and ordinary passenger service, with cylinders 20½ x 23⅝ ins. and driving wheels 78 ins. in diameter.

Mogul type for heavy passenger and light freight service, with cylinders 20½ x 23⅝ ins. and driving wheels 61 ins. in diameter.

Eight-wheeled all coupled heavy freight locomotive, with cylinders 21⅝ x 23⅝ ins. and driving wheels 53⅛ inches in diameter.

Mogul type tank engine for surburban service and short passenger runs, with cylinders 20½ x 23⅝ ins. and driving wheels 59 ins. in diameter.

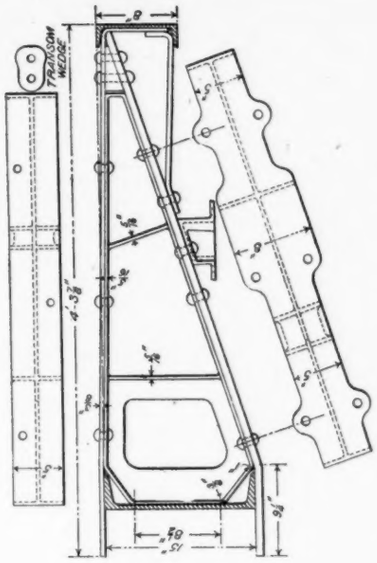
L. H. F.



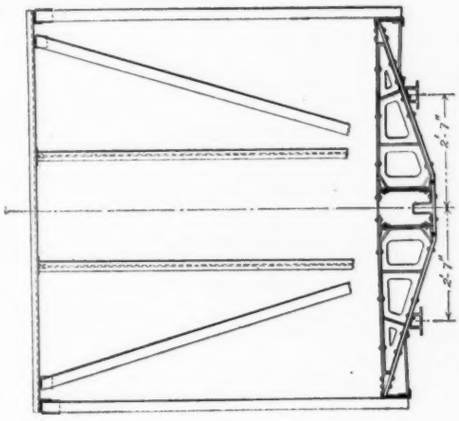
80,000 Pounds Capacity Steel Frame Box Car—Norfolk & Western Railway.

W. H. LEWIS, *Superintendent of Motive Power.*

C. A. SELEY, *Mechanical Engineer.*

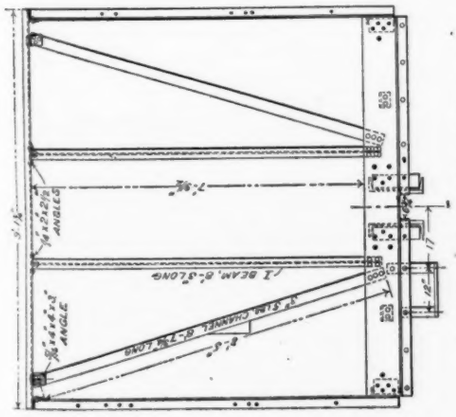


Standard Body Bolster for 80,000 lbs. Capacity Car.



Body Bolster Connection to Steel Framing.

80,000 POUNDS CAPACITY STEEL FRAME BOX CAR—NORFOLK & WESTERN RAILWAY



End Elevation of Steel Frame.

FORTY-TON STEEL FRAME BOX CARS.

Norfolk & Western Railway.

Following their interesting development of metal in their car construction, the Norfolk & Western has put into service the first of a lot of 100 forty-ton box-cars with steel upper and under frames, known as the "B. G." class. The accompanying drawings illustrate the frames which constitute the principal features of this car. The chief dimensions are as follows:

40-Ton Steel Frame Box Car.
Norfolk & Western Railway.

Weight, empty	38,000 lbs.
Light weight in per cent. of total loaded weight	32.2
Length inside	36 ft.
Length over side sills	36 ft. 9¾ ins.
Width inside	8 ft. 6 ins.
Height inside	7 ft. 6 ins.
Distance between center of trucks	27 ft.
Center sills	15 in., 33 lb. channels
Side sills	8 in., 11½ lb. channels
Posts and braces	3 in., 5 lb. channels
Corner posts	3 in. x 4 in. x ⅜ in. angles
End posts	4 in., 7½ lb. I-beam
Side plates	3 in., x 3½ in. x 5-16 in. angles
End plates	4 in., 5¼ lb. channels
Underframe diagonals	6 in. x 3½ in. x ⅜ in. angles
Intermediate sill supports	4 in., 5¼ lb. channels
Center and side sill connections	4 in. x 4 in. x ½ in. angles
Bolster and sill connections	3 in. x 3 in. x ⅜ in. angles

A trussed side frame, built to aid in carrying the load, in which the diagonal bracing of the center panel for the door openings is omitted, will appear to bridge designers as a little out of the ordinary, but the service test of 100 cars will tell the story, we think, satisfactorily. Those who wish to study the stresses involved will be aided by the discussion by Mr. J. H. Lonie, which is printed in this issue. This frame was developed very carefully and the designer was mindful of the fact that wood must be used for many purposes, such as the attachment of the flooring, siding and roofing. The use of steel in the upper frame is justified by giving it some of the load and the design is simple, sensible and skilful. The drawings show the various members clearly; also the methods of attachment. They also illustrate the substantial I-beam end posts. While the body bolsters are almost exactly like those of Mr. Seley's earlier designs, the detail is illustrated again because it appears to be giving perfectly satisfactory service. The large filling castings are of malleable iron. The trucks are the Norfolk & Western standard for 40-ton cars. They have 10 in. I-beam truck bolsters and diamond side frames.

Readers who desire to refer to the earlier steel frame cars of this road will find the 40-ton gondola illustrated in the American Engineer, April, 1900, page 100, and the 50-ton hopper car on page 42 of February, 1901. Another in the series will soon be illustrated.

GRAPHICAL METHOD OF DETERMINING STRESSES IN CAR FRAMING.

By J. H. Lonie, Norfolk & Western Railway.

With the advent of cars built wholly or partly of steel, we no longer depend entirely on the underframing to carry the load, but carry part of it on the side framing. The stresses in the various members can, of course, be obtained analytically, but for preliminary designing the graphical method affords a rapid solution, of sufficient accuracy for all practical purposes.

In Figs. 1 and 2 is shown the application of this method to a steel frame box car of recent design. The first step is

to lay out the center lines of the truss accurately to scale and to determine the amount and direction of the load which acts at each joint. A part of the load in each of the panels adjacent to the bolster will be carried directly to the bolster by the sills and will exert no influence on the stresses in the truss. It may, therefore, be ignored in the solution. In this particular case the members of the frame shown in dotted lines, Fig. 1, form no part of the truss proper and, for the sake of clearness, will be left out of consideration.

If we assume that, as is usually the case, the car is symmetrically loaded about the center of its length, it follows that $P = P_7$, $P_1 = P_6$, $P_2 = P_5$ and $P_3 = P_4$, P_1 and P_6 being the bolster reactions at the side sill $P_1 + P_6 = P + P_2 + P_3 + P_4 + P_5 + P_7$.

For convenience we may letter the truss as shown in Fig. 1. The members will then be designated by the letters of the spaces between which they lie. For example the diagonal marked x will be designated as J K.

The construction of the stress diagram is shown in Fig. 2. On a vertical line lay off, to any convenient scale, $AB = P_7$, $BC = P_6$, $CD = P_5$, $DE = P_4$, $EF = P_3$, $FG = P_2$, $GH = P_1$, and $HA = P$. It will be noticed that each load is laid off in the direction of its action. Through A draw a line, parallel to A I (Fig. 1), intersecting one through H, parallel to H I, at I: through I draw a line, parallel to I J, intersecting one through A, parallel to A J, at J; through J draw a line, parallel to J K, intersecting one through G, parallel to G K, at K; through K draw a line, parallel to K L, intersecting one through A, parallel to A L, at L; through L draw a line, parallel to L M, intersecting one through F, parallel to M F, at M; through M draw a line, parallel to M N, intersecting one through A, parallel to A N, at N. This completes the stress diagram as far as is necessary to obtain the stresses in the different members, since the stresses are the same in the corresponding members on the other side of the center line of the car. But it is well to complete the diagram as shown in dotted lines, continuing from N in the same manner as above. If the work is correctly done the closing line of the diagram, in this case T A, will pass through the starting point A. The lengths of the lines represent to scale the stresses in the corresponding members. For example, the length of the line J K represents to scale the stress in the diagonal J K.

From an inspection of the truss the character of the stresses in the different members, in this case, may be readily determined. For cases in which their character is not so apparent the following method may be used:

Cut the stress by a section about any joint, as Y, at which the direction of one force is known, and consider the truss as removed and the stresses in the cut bars as outside forces acting on the joint, as in Fig. 3. These forces are in equilibrium and the lines representing them in the stress diagram form a closed polygon. Their direction can, therefore, be obtained, when the direction of one force is known, by following around the polygon in the direction indicated by this force. From the stress diagram the force polygon for the joint Y is as shown in Fig. 4. From the truss it is readily seen that the action of the load P causes a tension in A J. The force in A J therefore acts toward the left. Following around the polygon in this direction we have the forces acting as follows:

A J to the left, A L to the left, L K downward, K J upward and to the right.

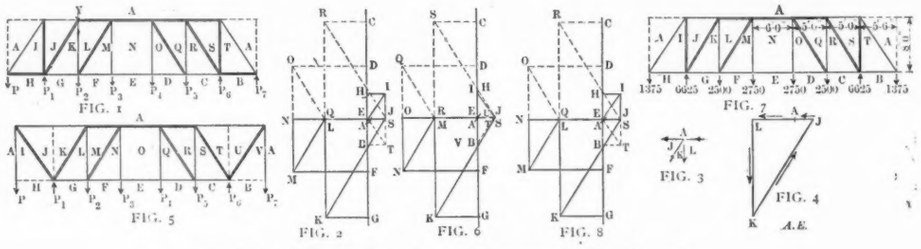
Putting arrows on the diagram of the joint to correspond with these directions, it is seen that A L and J K are in compression and that A J and K L are in tension. This method will apply to any case. In Fig. 1, members in tension are indicated by single lines, members in compression by double lines, and members which are under no stress, by dotted lines.

In Figs. 5 and 6 is shown the application of the method to the framing of a box car of usual design. It will be noticed that in this case the points H and I, J and K, B and V, and T and U coincide, showing that, as is to be expected, there is no stress in these members. The closing line of the stress diagram here is V A.

In all cases the side sill is under an additional stress to that shown above, due to carrying the floor load to the joints, and this should be separately calculated and added to that previously found.

It is believed that a study of the foregoing examples and method will enable anyone to solve all questions of car framing which will be met in usual practice.

For illustration the problem is worked out in two ways,



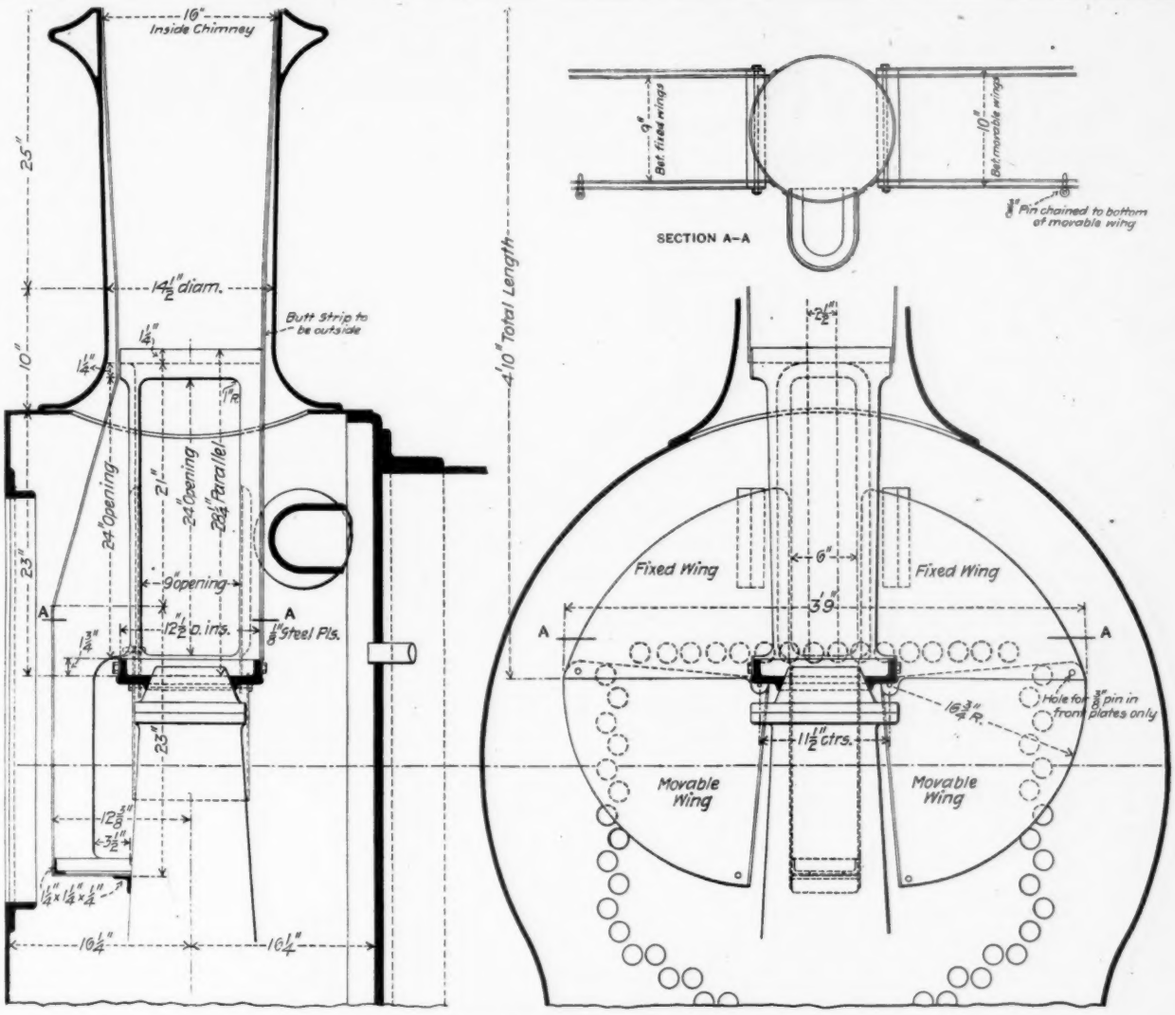
Graphical Determination of Stresses in Car Framing.

with an assumed load at 500 pounds per ft. on the side sills. The graphical method gives results agreeing closely with the analytical. As the stress diagram is constructed on the scale of 2,000 pounds per in., it will be seen that the degree of accuracy is a question of the scale used. Usually a scale at 1,000 pounds per in. is employed unless extreme accuracy is desired.

In the analytical method, Figs. 7 and 8, the length of O Q and R S is 9.433 and of T A, 9.70. A I is in tension $= 1{,}375 \times \frac{9.7}{8} =$ 1,667 lbs. H I is in compression = tension in A J $= 1{,}375 \times \frac{5.5}{8} =$ 944 lbs. I J is in compression = 1,375 lbs. A L is in compression = tension in K G $= 2{,}500 + 2{,}750 \times \frac{5}{8}$ = tension in A J = 3,281 − 944 = 2,337. J K is in compression $= 2{,}500 + 2{,}750 \times \frac{9.433}{8} =$ 6,190 lbs. K L is in tension = 2,500 + 2,750 = 5,250 lbs. A N is in compression = tension in W E = tension in M F $= 2{,}750 \times \frac{5}{8}$ + compression in A L = 1,720 + 2,337 = 4,057 lbs. M N is in tension = 2,750 lbs.

From the diagram:

A I scales, 27/32 in. =	1,687 lbs.
H I = A J scales, 31/64 in. =	968 lbs.
I J scales, 11/16 in. =	1,375 lbs.
A L = K G scales, 1 3/16 in. =	2,375 lbs.
J K scales, 3 7/64 in. =	6,218 lbs.
K L scales, 2⅝ in. =	5,250 lbs.
A N = N E = M F scales, 2 3/64 in. =	4,093 lbs.
M N scales, 1 ⅜ in. =	2,750 lbs.



Drummond's Front End Arrangement for Locomotives.
London & South Western Railway.

DRUMMOND'S "FRONT END" ARRANGEMENT FOR LOCOMOTIVES.

London & South Western Railway.

Through the courtesy of Mr. Duggald Drummond, chief mechanical engineer of the London & South Western Railway, drawings of his new patent draft arrangement for locomotives have been received. It is attracting wide attention abroad because of its fuel saving and spark arresting qualities.

The purpose of the arrangement is to distribute the effect of the draft from the nozzle over a large area in the smoke box. The greatest suction of the smoke box gases is around the exhaust nozzle. Mr. Drummond has surrounded the nozzle with a cup having wings at the sides. These wings are in two portions, the lower portions being hinged to give access to the tubes. These wings are closed at the bottom, so that the gases are drawn from the sides of the smoke box over such an area as to allow them to escape freely from the smoke box into the stack. He says: "We find our engines work best with the fuel we use at the minimum water vacuum of 2½ ins. and the maximum of 3 ins. By this arrangement the blast is distributed over a large area without creating a violent current, as in the old system, which was without this arrangement. The fire in the firebox lies at perfect rest and gives as nearly as possible the most perfect combustion that can be obtained in an open furnace. To work this satisfactorily with low partial vacuum a comparatively thin fire is required. The amount of ash in the smoke box averages one pound for every hundredweight of coal consumed. Not only does the arrangement remove the risk of fire, but a saving is effected in the fuel consumption, averaging about 7 lbs. per mile."

From records of tests received from Mr. Drummond it appears that this device secures a saving of about 26 per cent. in the amount of fuel burned to do the same work as other engines in a "gang." If it stops spark throwing it is easy to see how such a saving is possible, because Prof. Goss has found spark losses to amount to 20 per cent. in narrow firebox engines.

In addition to the wings already referred to, the drawing shows a vertical pipe in front of the exhaust nozzle, a portion of the circumference of which is cut away. It opens into the stack and above the wings are other openings through the pipe, all of which are supposed to distribute the effect of the blast.

This arrangement is not used in connection with Mr. Drummond's firebox water tubes, these engines having only the ordinary brick arch. With Welsh coal containing slack there seems to be no spark throwing and the fire resembles a gas furnace, the effect of the blast being similar to that of a fan. From a study of the drawing there seems to be no other explanation to account for the satisfactory action other than that of "uniform distribution." Undoubtedly the best spark arrester is one which will permit the coal to stay on the grates and burn in the firebox. It seems to be worth while ascertaining whether these devices will work on large engines with the freedom of steaming obtained by Mr. Drummond. This subject is worthy of interested attention. It is clear that there is much to be learned about draft appliances.

(Established 1832.)

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

Mr. C. W. Obert has been appointed associate editor of this journal, beginning his work with the June number. He has been connected with the staff of "Steam Engineering" as associate editor, and comes to us with technical preparation and experience in newspaper and railroad work.

In his report on the American Engineer Tests on Locomotive Draft Appliances, Professor Goss gives, in Section III., in this issue, some interesting and important information. He has found that for a given speed all points in front of the diaphragm have almost the same pressure, the variations recorded being generally less than 0.1 inch. These results justify the conclusion that while different points in the smoke-box show differences in pressure which are clearly distinguishable, the value of such differences is so slight that it does not seem necessary to take them into account in fixing the location of the draft gauge, except in so far as it indicates that the point of application should not be too near the steam jet.

Behind the diaphragm the draft is always less than in the main portion of the front end. The results show that approximately one-third of the total draft is required to move the air from the ashpan into the firebox, another third from the furnace through the tubes, and the remaining third from the front tube sheet under the diaphragm and into the main portion of the front end. A significant fact is that one-third of the draft effect is required to carry the gases past the deflector plate.

From the Sante Fe in its appointment of mechanical superintendents of several grand divisions of the road to have charge of the locomotive service outside of shop matters, comes a timely suggestion in connection with the specialization of responsibility. The time has come when large roads begin to find it necessary to specialize with reference to the important subdivisions, such as shop management and outside matters. Shop problems in large plants are becoming serious enough to require a "works manager" who does not divide his time between the shop, methods of firing, roundhouse service, the assignment of engineers and grievances of engineers and firemen. The shop is slighted if the proper amount of attention is given to these other matters and the roundhouse and road service on a large road are enough for another good man. The "master mechanic" must soon divide his duties on large roads, and the result cannot fail to be an improvement. It is becoming apparent that there will be a great demand for men who can operate large shops as the best manufacturing plants are operated, by shop superintendents. In fact, there is now a rather general search for good foremen, which is clearly indicated by correspondence from several directions. This is accompanied by applications from men who can take the responsibility of directing practice at roundhouses and look after the road service, with a view of obtaining uniform and improved practice. This appears to be a "sign of the times."

Roundhouse facilities for prompt work on locomotives between runs are being thoroughly overhauled on several roads. Attention is particularly directed to quick work in washing out boilers, and this requires large piping for blowing down the steam. It is inconvenient to allow steam to fill a roundhouse and the most approved method of blowing down is through an overhead pipe to which flexible connections to the steam dome may be made. This pipe may be led to a cistern and the steam used to heat water for filling boilers, or the steam may be blown into a cistern containing water blown down from the blow-off cocks of boilers, which is suitable for use again in boiler washing. Evidently the size of this pipe and its connections with the boilers is important. It must be a large pipe or the blowing down will cause a long delay. A 6-in. pipe, through the roundhouse over the engines, is not too large, and the blowing-down process may be accelerated by blowing part of the steam back through the injectors. In busy times every hour in the boiler washing counts, and it ought to be possible to thoroughly wash out a boiler in less than four hours. The question of damaging boilers by blowing down the steam pressure rapidly has been raised. It does not seem to be serious, however, because the stresses set up by a release of pressure are probably much less severe than those of rapidly raising the pressure in firing up. In the near future improvements in facilities for more prompt work in washing out may be expected.

Steel underframes for freight cars have usually been considered on the basis of durability. Irrespective of the cost of running repairs the decision in favor of steel underframes has usually been made because the increased cost of steel could be earned in the long life of the material. In some cases progressive men are lingering at the steel center sill, and even the steel draft sill stage, taking the view that with present relations between the prices of steel and wood, it will pay to renew two wooden frames reinforced in this way rather than pay the price of an all-steel underframe. This view is based on

the opinion that the most important function of the steel frame is in connection with draft stresses and that steel center or continuous draft sills are sufficient, giving all that is necessary to add at present to the wooden frames.

Recent experience with large all-steel hopper cars in trains with wooden cars indicate that these sills are not sufficient, and that the steel underframe is necessary on a basis of strength as well as the durability of material. It is doubtful whether a composite structure, such as a car underframe, can be made satisfactory, because of the great severity of the stresses, chiefly from buffing blows.

It must be recognized that the shocks in yard work nowadays are equivalent to the mild collisions of a few years ago, and probably nothing short of a full-steel frame, using both center and side sills to meet these stresses, will suffice. If a steel "backbone" is provided to meet these conditions it must bear practically all of the blows, for the wood will not assist. Figures will, before long, be published indicating that the shocks of ordinary service conditions in coupling large capacity cars are beyond even the imagination of those who have given the subject most thought. Furthermore, the favorable location of the draft gear between the center sills and the satisfactory disposition of the body bolster problem must be credited to the all-steel frame.

Present conditions indicate that it is advisable to make underframes as strong as possible, having a proper regard to the weight of the structure. This is chiefly because the shocks received from other cars in the train are greater and of a more destructive character than those of carrying the load. With the increase in the number of large capacity cars the necessity for protecting all cars increases.

LOCOMOTIVE ERECTING SHOP ARRANGEMENT.

Seldom is such an opportunity offered to compare shop plans as is given by the discussion of the new locomotive shops of the Buffalo, Rochester & Pittsburgh, at Du Bois, which appeared in our April issue. From time to time the arguments in favor of the longitudinal and transverse arrangements of shop pits have been presented in this journal, and until recently the longitudinal shop seems to have had the stronger advocates. In fact, the Du Bois shops are constructed on this plan, and it has Mr. R. H. Soule's endorsement.

A new view of the subject is unquestionably gaining ground. Formerly it was considered necessary to use a transfer table in connection with the transverse track arrangement, but now two large shops are nearing completion in which the approach is by means of turntables, and the engines are to be handled inside the shops by cranes. It is not necessary to review the arguments for each arrangement here; this has already been done in this journal, but it seems advisable to direct attention to a vital feature of the transverse shop, which has not had sufficient consideration. This is the convenience in passing from the engines to the machine shop. This is not a matter of crossing the pits (in the case of the longitudinal shop) alone, but is a question of actual distances from the machines to the locomotives.

In this particular case it is an open question whether the accepted plan at Du Bois as to the arrangement of buildings, with reference to each other, could not have been worked out very nicely in connection with a transverse erecting shop and without the use of a transfer table. In other words, given equal facilities for extending the buildings and getting engines into and out of the shop, the advocates of the transverse plan will not consider the case at Du Bois a conclusive argument against their views.

This plant has received most careful study, and the comparison of distances given in connection with the description is worthy of considerable attention. It may not always be fair to compare the distances between departments from their centers, because these measurements do not necessarily show the distances through which the movements of heavy material must pass, but such a study in connection with a shop plan is very important, and it should be a part of the preparations for every new shop.

THE PASS QUESTION AND THE JUNE CONVENTIONS.

The pass agreement, put into effect this year, is likely to affect the work of the Master Mechanics and Master Car Building associations next month unfavorably. A number of roads, chiefly west of Buffalo, have signified their willingness to furnish transportation to members, but nearly all will find it necessary to pay fare east of Buffalo. Of course the progressive roads will urge their representatives to attend and will pay their expenses, but those needing the aid of the associations most may not be represented, because of this extra expense.

We publish a letter dated April 15, from Mr. G. W. Rhodes, Assistant General Superintendent of the Burlington & Missouri River, to the president of the Master Car Builders' Association, giving the views of one of the most faithful and influential members, as follows:

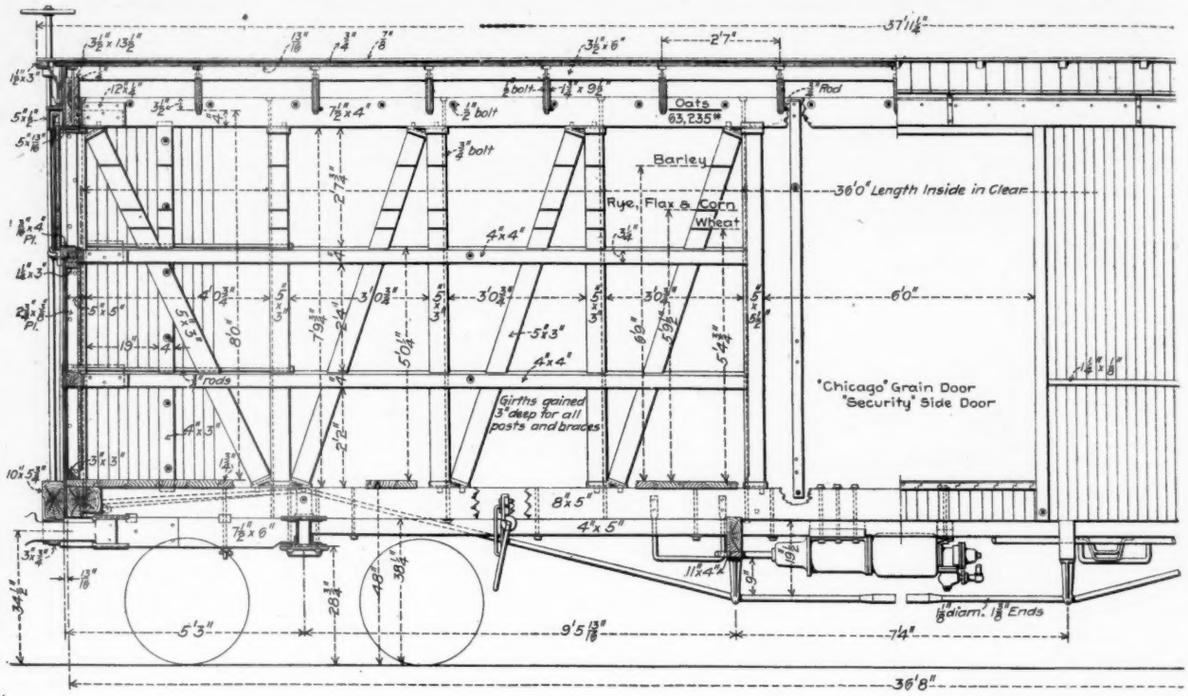
We understand the principal Eastern railroads have decided that they cannot consistently give the members of the M. C. B. Associaton and American Railway Master Mechanics' Association transportation to attend their annual conventions this year at Saratoga.

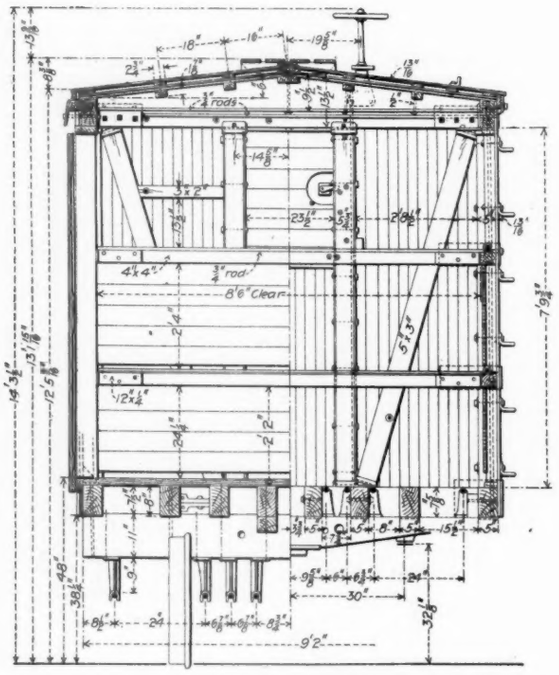
This, it seems to me, is very unfortunate. These two associations have done more, perhaps, than any other organization in this country to build up the high standard of car and locomotive construction that we now enjoy. Not only does our equipment compare favorably with that of any other country, but the Government has adopted some of our standards, in so far as safety appliances are concerned, and they now form part of the laws of the country.

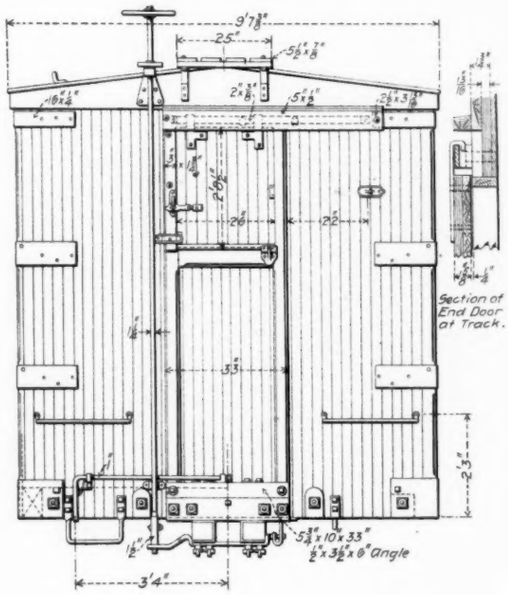
When the executive committee of our two associations met and selected Saratoga for the place of meeting for the year 1902 they undoubtedly did so on the assumption that the same facilities for transportation would be given to members of the association and their families as has heretofore been given. Since this action was taken the Eastern roads have adopted new rules in regard to transportation, and it seems to me the executive committee, for the good of the association, ought to at once meet and reconsider their action. The gathering at Saratoga, under the present conditions, in the opinion of many of the M. C. B. members, will be a very tame and poorly attended affair. This would be entirely obviated if the executive committee would decide on selecting some Western point for the conventions. Either Chicago or St. Louis has ample hotel accommodations for all the people the associations can get together. The recent successful gathering of the American Railway Engineering and Maintenance of Way Association, held at the Auditorium Hotel, Chicago, has shown clearly that it is not necessary to go East for a successful convention. We have always felt that the Western members hardly got the attention that they ought to have in so frequently holding our annual conventions in the East. There never will be a better opportunity to give the Western members a little attention than now offers, and, voicing the opinion of a good many Western members, we would urge that the executive committees reconsider their action and select some Western town within the pass territory for the June conventions.

The above is not written with the idea of any criticism of the action the Eastern roads have taken on the pass situation. It is written solely in the interest of having a large and profitable gathering at the mechanical men's annual conventions. This would seem to be best served by holding the meeting at the extreme limits of the new pass territorial districts.

It is too late to change the meeting point this year, and it is doubtful whether anything would be gained by such a course. If these pass agreements do not permit of modification or exception for such a purpose, the railroads must pay the expenses of their representatives or they will suffer an irreparable loss. Now that the greatest operative problems are those of the mechanical departments, it is incomprehensible that anything should be allowed to threaten interference with good attendance, which always means the success of such gatherings.







80,000 Pounds Capacity Box Car—Illinois Central Railroad.

Built to Standard Measurements.

80,000 LBS. CAPACITY BOX CARS.

Illinois Central Railroad.

Built to New Standard Dimensions.

This car was designed to meet the American Railway Association standard inside dimensions, and 1,500 are to be built next summer by the Pullman Company. In determining upon the exterior dimensions, careful consideration was given to the recommendations of the committee of the Master Car Builders' Association, as stated on page 17 of our January issue of the current volume. The height of the car at the eaves, measured from the rail, is 12 ft. 5 9-16 ins., which is within the distance recommended. The height of the upper surface of the floor from the rail is 4 ft.; the width and height inside are 8 ft. 6 ins. and 8 ft. respectively; the width at the eaves is 9 ft. 7⅞ ins., and the minor recommendations have also been considered. This construction provides for the coupler below the end sill, this member not being cut. There is a strong objection on the part of motive power officers to the cutting of the end sill for the coupler. In this case the end sill is turned on its thicker side and the floor maintained at a height of 4 ft. from the rail. The posts at the end doors are stiffened by plates, as shown in the end view and transverse sections. All the posts and braces are fitted to castings at

the plates and sills, and the castings at the upper ends of the end door posts have substantial lips over the end plates to give additional strength at these points. These cars have Chicago roofs, Security doors and Chicago grain doors. Five hundred of them have Fox trucks and the remainder, 1,000, have Kindl trucks. We are indebted to Mr. Wm. Renshaw, superintendent of machinery of the Illinois Central, for the drawings.

THE WATER QUESTION.

II.

(Continued from page 127.)

Incrustation.

Let us take up first the matter of incrustation, which seems the most important. An analysis usually discloses the fact that scale is formed by the precipitation from the water, by means of heat and evaporation, of salts of lime and magnesia. Any method calculated to remove scale already formed should be dismissed at once. To attempt to take out scale after it is formed in the boiler is an effort directed against a result and not a cause. An attempt to remove old scale is merely an attempt to hide the marks of disease, the malady having run its course. It is obvious that any substance powerful enough to dissolve scale would have a tendency to dissolve the metal of the boiler. Many boiler compounds, intended for this purpose, contain ammonium chloride, which, under the heat of the boiler, gives off muriatic acid. That this is injurious to the boiler need not be stated. The treatment of water intended for steam raising purposes so as to prevent incrustation may be divided under the following heads:

Use of Blow Off Cock.—This is efficient only to a small degree, because blowing off can only get rid of matter in suspension or solution in the water, and has no effect upon scale fastened to sheets and flues. All matter in suspension or solution can be blown out of a boiler only by entirely emptying the boiler. The blow off cock is of great use where foaming is caused by the concentration of soluble salts, like sulphate of soda or common salt, in the boiler, enabling the engine man to dilute the concentrated solution with fresh water. Engineers hesitate to use the blow off, due to fear that a piece of loose scale may lodge in the valve and prevent its being closed. Instances of locomotives "dying" on the road from this cause are not uncommon.

Use of Internal Collecting Apparatus or Skimmers.—All water in the boiler must pass this device, which, when it acts, only affects the carbonates. The working condition of such apparatus can only be ascertained by examination inside the boiler.

Heating the Feed Water.—Practice has shown that open heaters are most effective for water purification, but they only affect incrusting solids to a limited extent. The drain upon a passenger locomotive for heating cars is already great. Exhaust steam is not available, being used in all classes of locomotives to produce draft, and the question of carrying an open heater upon a locomotive is open to obvious objection. Heaters are certainly of great value, but from the fact that there is hardly a stationary plant in the country using a heater which does not have scale in the boilers we must draw the conclusion that heaters do not accomplish what is claimed for them.

Filtration.—Some waters carry in solution but a small proportion of scale forming solids, but hold in suspension much mud and silt. For the treatment of such waters filtration is well adapted.

Distillation.—This method without doubt produces a pure water and leaves behind all solids, whether in solution or suspension. Two important points here require consideration. The first is the cost. Below are figures taken from actual experience upon the distillation of water from a common steam boiler:

COST OF DISTILLING 50,000 GALLONS OF WATER IN 10 HOURS.

Conditions:

Condensing water at 60 degrees F.
Boilers and condensers clean.
Coal on track at $1.50 per ton.
Labor ten hours per day at $1.50 per day.
Temperature of steam entering condensers 215 degrees F.
Temperature of distilled water leaving condensers 100 degrees F.
Condensers so arranged that distilled water runs by gravity into storage tank.
Pumping water over condensers 40 feet from ground, 1½ cents per thousand gallons.
Evaporative power of coal, 7.
Twenty gallons condensing water to condense one gallon of distilled water.

Cost:

Thirty tons of coal at $1.50 per ton		$45.00
Pumping 1,000,000 gallons condensing water at 1½ cents per thousand gallons		15.00
Unloading car, one day at $1.50		1.50
Firing, carrying away cinders (about 4 tons), and attendance on plant, 2 men at $1.50 a day		3.00
Interest on investment at six per cent., 5 250-H. P. boilers set and connected	$11,000.00	
Condensers	4,000.00	
Pumps and housing	3,000.00	
	$18,000	
Interest, six per cent., $1,080.		
Interest one day		2.96
Cost of 50,000 gallons		$67.46
Cost per 1,000 gallons		1.35

We have not taken into consideration the use of triple or quadruple effect evaporators, for which claims are made for the production of distilled water at a cost as low as 34 cents per thousand gallons, because machinery of this class is complicated and very expensive. We are informed that a plant to do duty as above described would cost in the neighborhood of $40,000. Aside from the fact that the cost of distilled water is almost, if not quite, prohibitive, we must not forget to consider that by the distillation of water scale is only transferred from the boiler of the locomotive to the boiler of the distilling apparatus. An objection which can, however, be overcome is that distilled water is too pure. It is a well-known fact that pure or distilled water is a solvent of iron. Stationary steam plants using condensing engines and returning condensed steam to the boilers find corrosion or pitting taking place unless a portion of undistilled or impure water is mixed with the returns from the condensers. A distilling plant could be placed between two stations where water could be obtained containing sufficient lime and magnesia to mix with the too pure distilled water and prevent its corrosive action.

Chemical Treatment.

The first thought which naturally occurs in studying this question is the use of some substance which will precipitate the offending material. This material is usually lime and magnesia. Substances having the property of producing precipitates of varying degrees of insolubility with lime and magnesia and other incrusting solids are numerous, and have been introduced by the thousands. The addition to the water in the boilers of any substance having in view the precipitation of the incrusting solids can, from the very nature of the thing, have but one result, namely, to add to the offending material already there. Indeed, if it were possible to remove scale-forming material by treatment within the boiler, it would not be desirable, since the boiler has neither room nor energy to spare for chemical or mechanical operations.

The chemistry of boiler compounds is correct, and has been for years well understood, but a remedy to be effective must be applied in a proper manner, at a seasonable time, and in the right place. Simply because a substance will, when put into hard water, precipitate lime and magnesia, is no reason why this substance should be put into the boiler. Quite the contrary. Heat, without chemicals, causes the precipitation in the boiler, and that is just the thing which is not desired.

Before proceeding to the consideration of the proper place in which to precipitate this offending material, it would be well to consider the substances available for this purpose, their efficiency and economy.

The following tables give the amount of the various sub-

stances required to precipitate one pound of carbonate of lime, and also one pound of sulphate of lime, and the cost of so doing. Where possible, the figures are taken from the advertisements of persons selling these substances as boiler compounds or for the manufacture of boiler compounds. These substances, though few in number, are fair representations of the class of materials sold and used. It would be impossible to list all of them here. Such a list would require a large percentage of the nouns in the English language.

One pound of carbonate of lime requires for its precipitation:

			cents.
	.56 lbs	of lime at .25 cent per pound	.14
or	2.18 "	" tri-sodium phosphate at 4c. per pound	8.72
or	.80 "	" caustic soda at 2c. per pound	1.60
or	3.15 "	" barium hydrate at 2.50c. per pound	7.87
or	11.92 "	" tannin extract, 27 per cent., at 2.75c. per pound	32.78
or	2.28 "	" sugar at 5c. per pound	11.40

For the removal of sulphates and chlorides one pound of sulphate of lime requires for its precipitation:

			cents.
	.85 lbs.	of soda ash at one cent per pound	.85
or	1.94 "	" sal soda at .65c. per pound	1.26
or	1.53 "	" barium chloride at 2c. per pound	3.06
or	8.76 "	" tannin extract, 27 per cent., at 2.75c. per pound	24.09
or	1.68 "	" sugar at 5c. per pound	8.40
or	1.60 "	" sodium phosphate at 4c. per pound	6.40

An examination of the above tables shows conclusively that lime and soda are the most efficient, and, at the same time, fortunately, are the most economical substances for the removal of scale-forming material from water. They are also the most available, being obtainable at any time in the open market.

Returning to the question of the proper time and place in which to use these chemicals, it seems that but little philosophy is required to conclude that water is no exception to the rule that a thing must be purified before it is used and not afterwards. There are a number of good reasons why it would not be practical to attempt to purify water upon the engine. Most prominent among these reasons are the following:

The constantly increasing number of devices requiring the attention of the engine driver will make it seem best that an apparatus for the purification of water be in charge of some one whose duties are less numerous. The reason which, in our opinion, at once shuts out any apparatus intended for the purification of water upon the locomotive is that locomotives must use several different waters, and any efficient apparatus would necessarily have to be reset to treat varying waters and it is manifestly impossible to provide a mechanism with the guiding instinct to make these variations automatically and without human aid. Coupled with this are questions of space and weight, and the economy of a separate apparatus for each locomotive.

Owing to these facts it would seem that the most logical location for a softening or purifying plant would be at the source of supply. At such a point as this the apparatus would be in charge of the water pumper, or some similar employee, without extra cost for attendance. It is needless to say that such employees are not versed in chemistry, and the apparatus must be so simple that the pumper will have no difficulty in its operation.

Having then decided that the proper place or location of the purifying or softening plant is at the source of supply, we must carefully consider the functions necessary to make this apparatus desirable, economical and, above all, efficient.

In the first place this apparatus should be easy of access. It should require no heat in the purification of the water. It should be easily cared for by one not skilled in chemistry. It should require but little time for attendance. It should not give rise to back pressure on the pumps, thus requiring extra steam for operating them. The machine should be continuous in its action. The apparatus should deliver water at such height that it will flow by gravity into the storage tank and not require repumping. It should be automatic, starting and stopping the feed of reagents with the starting and stopping of the flow of water. The apparatus should automatically treat varying quantities of water with varying quantities of material without resetting, and be as economical in the use of these materials as possible. Above all, the apparatus should be of such construction that the liability of freezing is reduced to a minimum. It should consist of as few parts as possible. It should be of such size that the water will take at least three hours to pass through it, so that the reaction may be completed before the water enters the storage tank. If possible the storage tank should be a part of the apparatus.

The use of lime and soda for softening water is called the Porter-Clark process, named for the discoverers. Attempts to use this process directly in the roadside storage tank by pumping into the main supply pipe solutions of lime and soda have resulted in failure, due to the difficulty of making pumps throw at all times the proper amounts of the reagents, and to trouble experienced in getting the precipitated matter to settle in the tank, where the water is agitated frequently by the outflow of water drawn for locomotives. The greatest difficulty, however, has been experienced with the sludge or mud resulting from the process, which generally amounts to 500 or 1,000 lbs. a day, this large amount of mud resulting in the necessity of very frequent cleaning of the tank. Apparatus, filling to a greater or less degree the requirements of an efficient water softener, are now upon the market, some of which are meeting with very gratifying success. An apparatus meeting the requirements as stated above should be all that is desired.

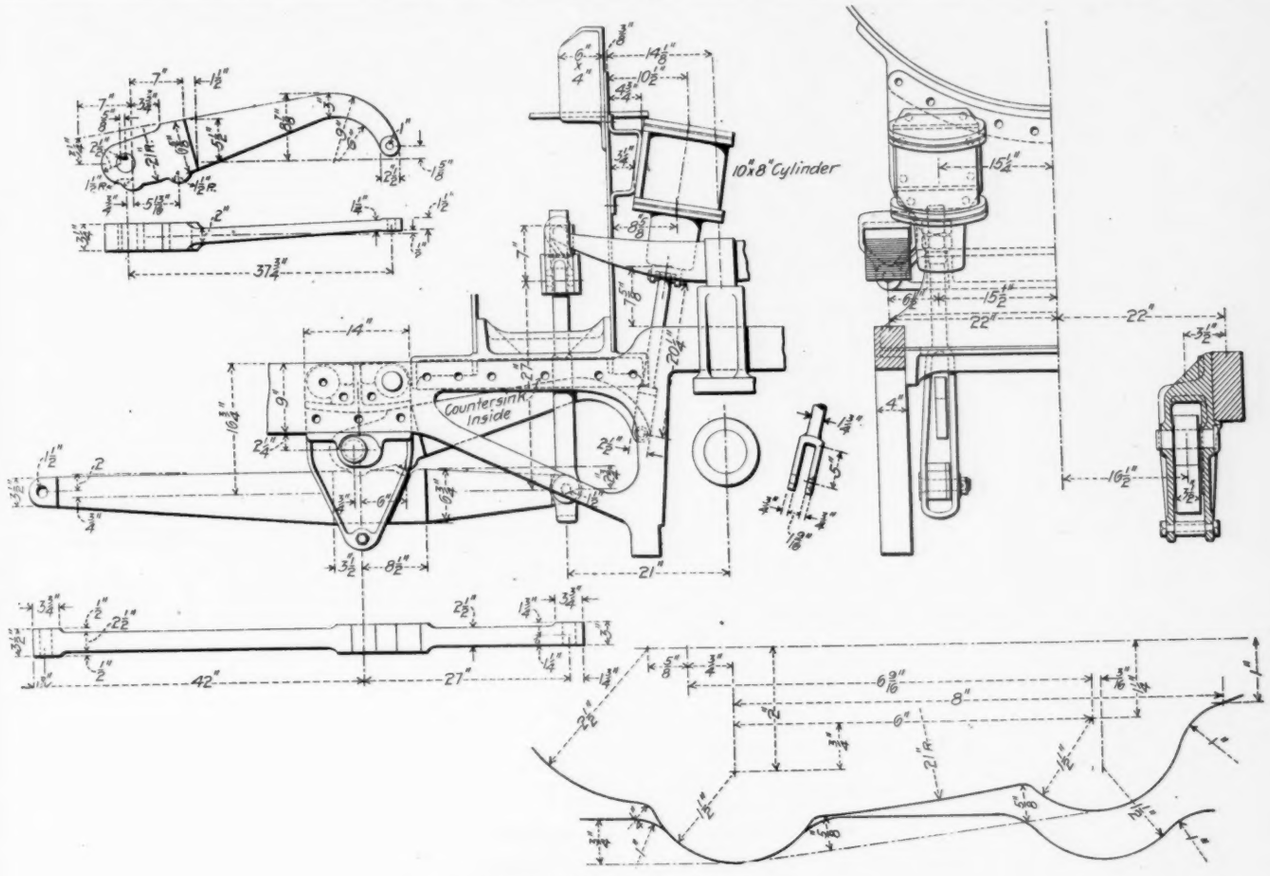
We have taken up here the treatment of waters for the removal of scale forming solids only. Corrosion and foaming are due to causes apart from scaling, and are subjects for further consideration.

AN IMPROVED SAND DRIER.

A drawing has been received from Mr. Charles Linstrom, mechanical engineer of the Chicago & Alton, showing the construction of an improved drier devised by him for drying locomotive sand. This improvement consists in the introduction of a coil of pipe in the drier of the usual form, by means of which the vapor from the wet sand finds a ready means of escape from the mass of the sand. In this construction the vapor, as it is driven out of the sand, passes through small holes in the bottom of the coiled pipe and escapes to the smoke flue or passes outside of the drier. If such a precaution is not taken the vapor may not be entirely driven off, which results in leaving portions of the sand wet so that they may clog the sand pipes, or it may accumulate a pressure which either dislodges the sand from the heater or bursts it. Furthermore, the retention of the moisture reduces the capacity of the apparatus. In this device the lower end of the pipe is closed with a cap, which may be removed to empty the pipe from possible collections of sand. In a comparison made at Bloomington Mr. Linstrom found the following results:

	Without coil.	With coil.
Sand dried, pounds	6,870	7,425
Coal used, pounds	346	320
Duration of comparison, hours	10	10
Increase of capacity, per cent	.....	8
Reduction of coal, per cent	.....	8

The Kansas City Belt Railway has recently received a large switching engine from the Baldwin Locomotive Works. It is intended to operate over 1½ per cent. grades. Its total weight is about 185,000 lbs., and it is of the four-wheel-coupled type, with wheel base 15 ft. 4 ins. The leading and trailing wheels only have flanges. The cylinders are 21 x 32 ins. An inside admission piston valve, 10 ins. in diameter, is used. The steam pressure is 210 lbs. Driving-wheel diameter, 57 ins. This powerful engine exerts a tractive force of 44,190 lbs., the adhesive ratio under ordinary conditions being 4.1. The heating surface is 2,666 sq. ft., of which 220 is in the firebox, and the grate area amounts to 33.5 sq. ft. The tender is of the sloping back type, 4,000 gallons capacity, and is carried on two Player cast-steel trucks.



Locomotive Traction Increaser.
American Locomotive Company.

LOCOMOTIVE TRACTION INCREASER.

American Locomotive Company.

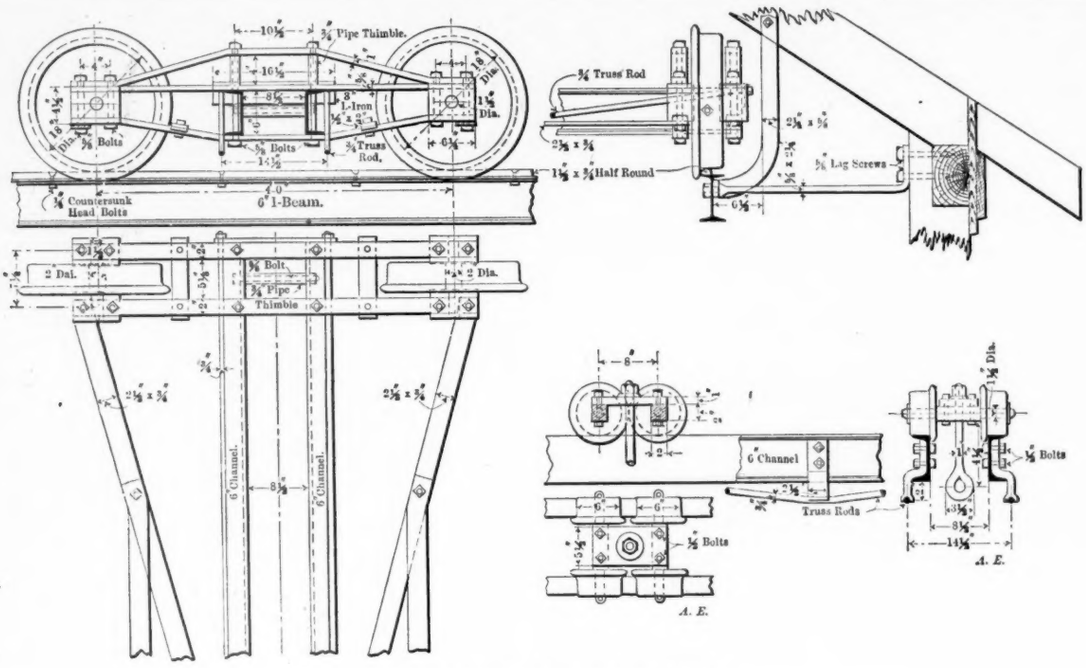
In order to temporarily increase the weights on the driving wheels for the sake of increasing the tractive weight of locomotives in starting trains, a number of different "traction increasers" have been devised by the locomotive building firms. On page 39 of our February number of last year the Schenectady design was illustrated in connection with the large passenger engines of the New York Central. On page 372 of the December number a design for applying the same principle to prairie type Baldwin locomotives for the Santa Fe was shown, and the present illustration was prepared to show the arrangement devised at the Brooks works of the American Locomotive Company for application to "Chautauqua" type engines recently built for the Pere Marquette.

These engines are similar in their general features to those of this type which we have illustrated, a typical example of which will be found in the April number of 1901, page 101. The traction increaser is applied to the trailer equalizers and is apparently of the simplest possible construction. It consists of a 10-in. air cylinder, a piston, piston rod and a lever whereby the equalizer fulcrum is moved a distance of 6 ins. by rolling the levers into their new positions under the pressure of air in the cylinders. The fulcrum lever is always in contact with the equalizer, and the location of the normal projection on the lever is such as to cause the weight of the engine to tend to raise the piston in the cylinder and keep the device in its normal position. A glance at the engravings will make this clear.

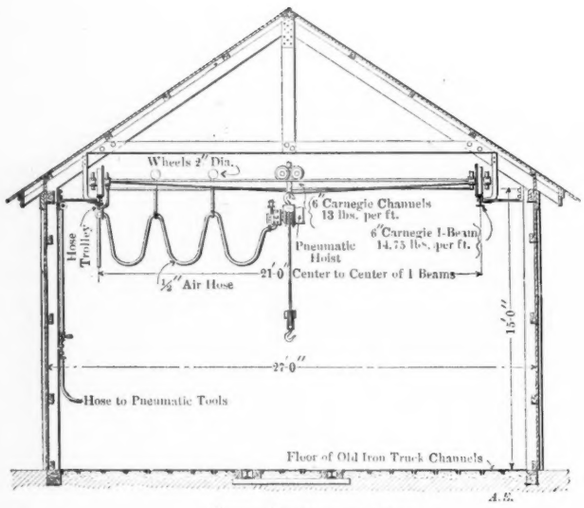
This particular case was worked out to increase the weight on drivers about 8,000 lbs., but this amount may be varied in different constructions as desired.

The Southern Pacific Company recently contracted for seventy-two steel tanks for the storage of fuel oil. About 50,000 barrels is to be the average capacity of each tank, and the entire storage capacity of this new equipment will equal 3,600,000 barrels. Thirteen tanks are now in use, ten west of El Paso and three east of that city. They hold altogether the contents of 650,000 barrels. When the new steel tanks are delivered, twenty-one will be placed on the lines between Los Angeles and San Francisco, Cal., and Ashland, Ore., thirteen between Los Angeles and Deming, and thirty-eight will be placed along the company's lines in Texas. This road has 125 oil-burning locomotives west of Ogden and El Paso, which is about one-third of the total number of engines in use. East of El Paso about eighty locomotives have been converted into oil burners.

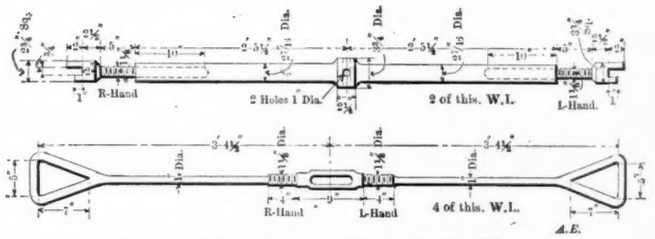
A long-rail experiment is being made on the Michigan Central Railroad. It consists in butting together perhaps seventeen 30-ft. rails without any allowance for expansion, with splies screwed up very tightly with machine-made bolts, thus securing practically a 500-ft. rail. At the ends of this long rail specially designed slip joints are used, where expansion is fully provided for. At Detroit, where a number of these composite long rails are being tried, the center is anchored by bedding several ties in a concrete foundation and slot-spiking the joint splices. At Saginaw, where more of these long rails are being tried, the anchoring of the center is accomplished by bedding a 15-ft. vertical rail in concrete in a hole excavated in the roadbed. The top of this anchor rail fits into a notch in the horizontal leg of a splice bar on the track rail. Mr. A. Torry, chief engineer, is conducting these experiments.



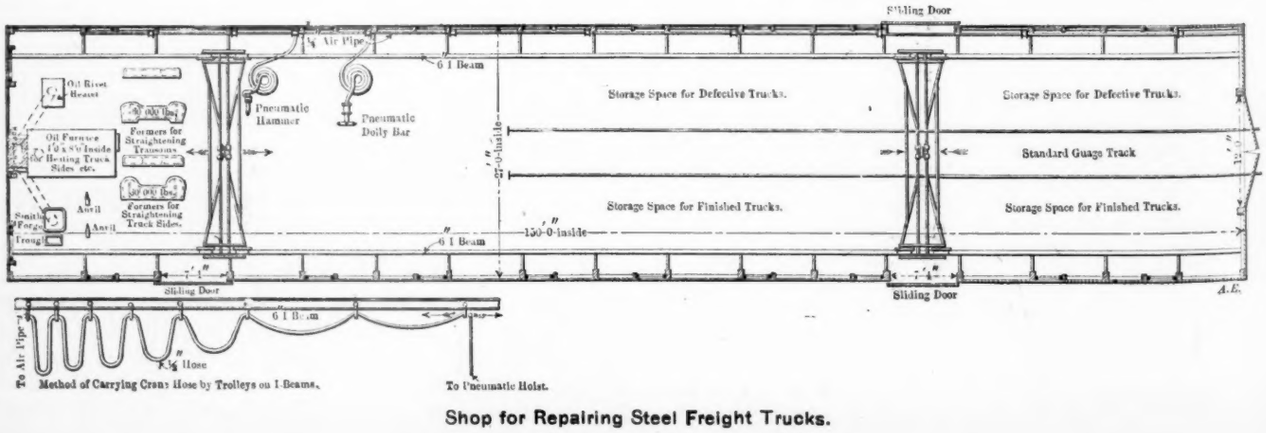
Details of Cranes for Handling Trucks.



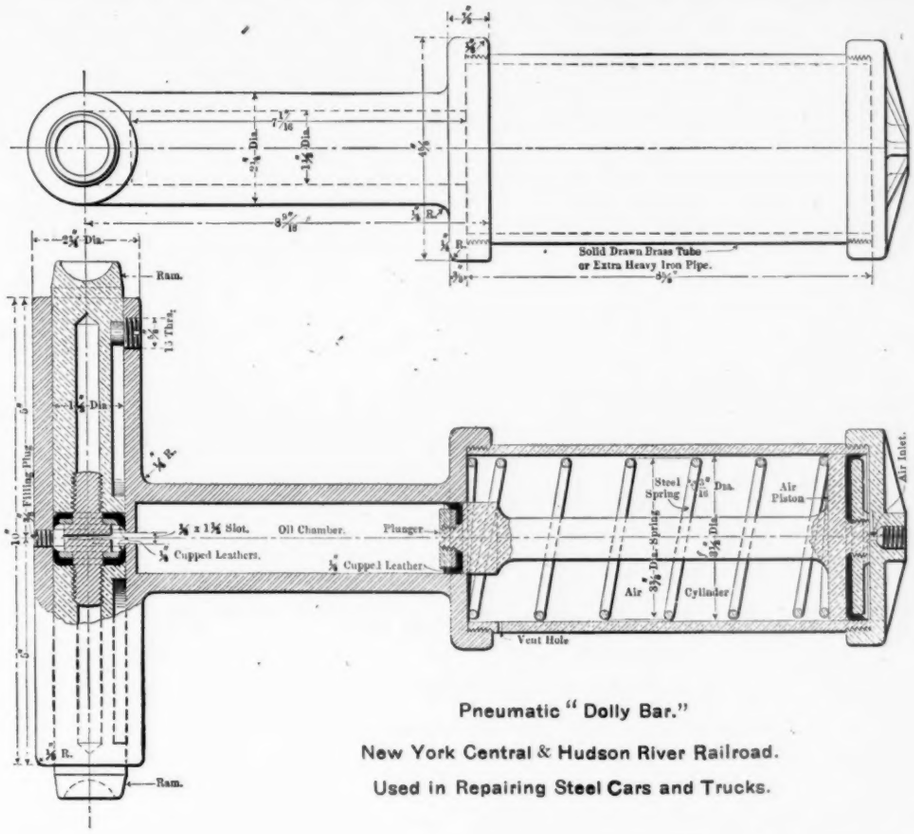
Cross Section of Shop.



Push and Pull Jacks for Straightening Plates.



Shop for Repairing Steel Freight Trucks.
New York Central & Hudson River Railway.



Pneumatic "Dolly Bar."

New York Central & Hudson River Railroad.

Used in Repairing Steel Cars and Trucks.

SHOP FOR REPAIRING STEEL FREIGHT CAR TRUCKS.

New York Central & Hudson River Railroad.

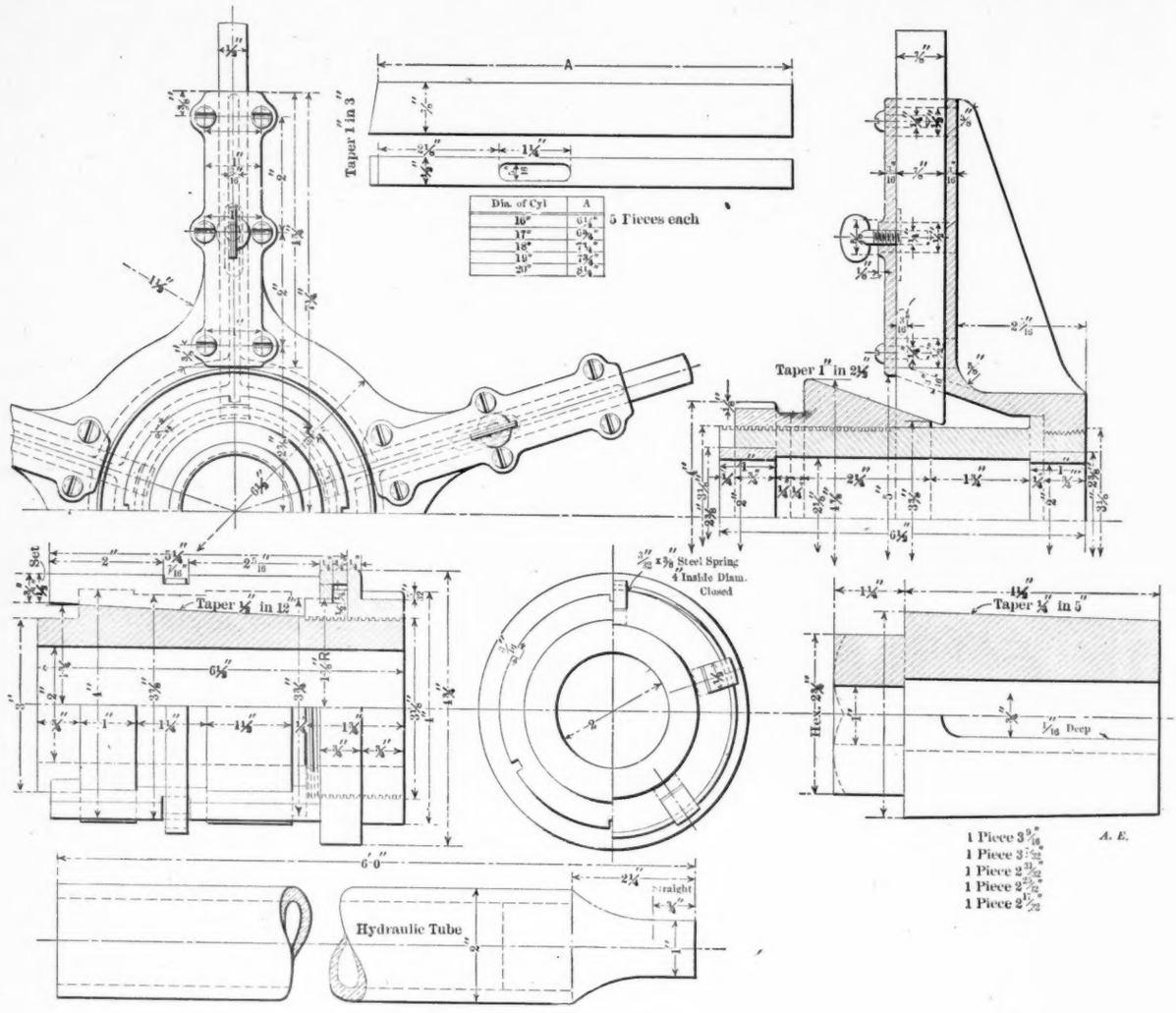
Steel freight trucks requiring repairs on the New York Central Railroad are all sent to East Buffalo, where a convenient shop has been equipped with special facilities for dealing with them. This shop is 150 ft. long by 27 ft. wide, and is equipped with two traveling cranes running the full length of the building, the cranes being fitted with pneumatic chain hoists, which permit of holding the trucks in any desired position for riveting. The present output of this shop is 60 trucks per month, at a cost of $2.65 for labor and $6.75 for material, or $9.40 per truck, including all labor and material from the arrival of the trucks until they are stored ready for use again. This cost has been reduced from an average of $26 per truck, the expense necessitated by the previous method of sending the trucks to the builders for repair.

This shop is equipped with pneumatic drills and reamers, a hydraulic hand punch and a pneumatic hammer, for riveting. For bending plates and transoms pulling and pushing jacks are used. For riveting a pneumatic "dolly bar" is employed. It has a holding pressure of 1,000 lbs., and employs air pressure in the large cylinder, which forces oil into the small holding cylinders. These devices are illustrated in the engravings, which also show the construction of the travelers and the method of transmitting air pressure for hoisting. Cast iron formers are used for the side frames of the trucks, and the plan view of the shop shows the locations of the furnace, forge and rivet heater. The "dolly bar" has an extension piece to reach across a truck.

Nearly all the trucks repaired at this shop are damaged through unfair usage. Only about 2 per cent. are damaged otherwise. With more than 55,000 pressed steel trucks in service on this road, and the records cover three years, not one accident has occurred through a failure of one of them. Mr. F. A. Brazier, assistant superintendent of rolling stock of the road, is authority for this statement, and he also says that within the last two months 17 arch bar trucks have broken on that system, causing in some cases quite serious accidents. Of these 17 trucks, 13 had broken arch bars, and the other 4 were cases of broken column bolts.

We are indebted to Mr. A. M. Waitt, superintendent of motive power and rolling stock, for these drawings.

A snow plow with a "turntable attachment" has been put into service on the Delaware, Lackawanna & Western Railway. As illustrated in the "Railway Review," a turntable track about 5 ft. in diameter is built on the front truck. At or near the center of the plow, or rather at the balancing point, there is a bolster with a center bearing arranged to fit the truck, and six wheels, 8½ ins. in diameter, radially disposed, are located so that they will bear upon the turntable track. At the front are two cylinders, placed vertically, and operated by compressed air. The outer ends of the piston rods bear upon blocking placed upon the ties, and when air is admitted to the cylinders the front end of the plow is raised as upon air jacks. When in this position the front truck may be pushed back under the central bolster and the air released. The whole plow is then carried on the turntable truck, with the rear truck hanging clear of the rails. It is said that three men can then turn the plow around. Air is again used to take the weight of the front end, and this places the rear truck down on the rails and frees the turntable truck, which can be pushed forward to its normal position and the front of the plow lowered upon it. The advantages of this arrangement are obvious. The forward truck, when in turntable position, can be more easily oiled and examined than when closely housed under the nose of the plow. The plow can be turned at any point on the road, and is, by reason of its construction, even more satisfactory than a double-end plow. This form of plow obviates the necessity for an intermediate turntable or Y as far as snow plows are concerned.



The Aurora Guide Setting Bar.
Chicago, Burlington & Quincy Railway.

A CONVENIENT GUIDE SETTING BAR.

Chicago, Burlington & Quincy Railway.

In various shops of the Chicago, Burlington & Quincy the cost of lining up guides has been greatly reduced by the use of the device which is illustrated in the accompanying engraving. It is also in use at the Baldwin Locomotive Works and at the Pittsburgh works of the American Locomotive Company. It is called the "Aurora Guide Setting Bar," which would lead to the conclusion that it was devised at the Aurora shops of the "Burlington."

The guides are set by means of a crosshead plug carried on a bar 6 ft. long, which appears in the lower left hand corner of the engraving. It is held in line with the cylinder by two guides, one being in a spider fitting the bore of the cylinder and the other is in an expansible mandrel fitting the packing opening in the back cylinder head. The method of setting the arms of the spider with the taper bushings and use of the mandrel for the other support are made clear in the drawing. Five lengths of arms are provided for the spider and five plugs for the crosshead fit. The construction is ingenious. A complete bar costs about $90, and it reduces the cost of setting guides fully one-half, besides making a positively true alignment.

THE HEAVIEST LOCOMOTIVE IN GREAT BRITAIN.

The tendency in modern locomotive engineering practice is to provide boilers and fireboxes with maximum possible capacity in respect to steam generation. In dealing with this matter, effective heating surface plays a very important part. Mr. Chas. R. Rous-Marten, in a recent issue of "The Engineer," discusses some features of this modern tendency. Large and powerful boilers, however, are not all; it is, at the same time, necessary to develop the means by which the gain in boiler power can be practically utilized, and turned into effective haulage. The Great Western Railway of England has lately turned out, at its Swindon shops, what is said to be the heaviest engine in Great Britain. Mr. William Dean's new machines weigh, in working order, without tender, 69 tons. The boiler is 14 ft. 8 ins. long, with a Belpaire firebox, 9 ft. long. The total heating surface is 2,400 sq. ft. and the steam pressure is 200 lbs. per sq. in. The driving wheels are 80½ ins. in diameter, and the cylinders, placed outside, are 18 x 30 ins. These engines will have 121.5 lbs. tractive force for every pound of mean effective pressure, and about 50 tons of adhesive weight with which to utilize it. These engines, when compared with others in England, are found to be two tons heavier than Mr. W. Wordsell's North Eastern six-coupled type, and ten tons heavier than Mr. Aspinal's large engines on the Lancashire & Yorkshire.

COMMUNICATIONS.

TREATMENT OF SPECIAL APPRENTICES.

To the Editor:

I have read with considerable interest the communication signed "A. A. G." in your March issue, and must say that my personal experience has not contained any such disagreeable incidents as he mentions. In fact I have invariably received the most courteous treatment in various shops and am usually able to obtain considerable information and keep on the right side of the men. I have never heard of any deliberate attempts to injure special apprentices, but, on the contrary, have been warned whenever I have carelessly or ignorantly exposed myself. "A. A. G." should try another part of the country.

There is no doubt but that the wages paid to college men entering railroad work as special apprentices are very low and do not offer much inducement. In my humble opinion, however, the average college man who has not had any practical experience is of very little value to a railroad company until he has acquired that experience and realized that his college degree does not make him a superior being who should be paid for existing.

In general, I think that if a college man will forget his fancied superiority, he will be able to acquire a great deal of information concerning practical questions, and that he will also learn that it is not necessary to be a college graduate in order to be a gentleman.

Chicago, April 1, 1902. "Q."

[Editor's Note.—This view of compensation will be approved by all. Inducements to enter shops will not bring good results. The promising future before a successful mechanical railroad officer ought to be sufficient. Coddling does not make strong men.]

LOCOMOTIVE CINDERS AND SPARKS.

How cinders are made is an exceedingly interesting topic—a "hole" in the fire, friable coal, or light particles not cemented together with water, thrown into that strongly pulsating storm center of air and gas, flame and carbon, which is found in the locomotive firebox, when the engine is working hard; these are the conditions favorable to the formation of sparks and cinders. Prof. W. F. M. Goss, of Purdue University, discusses this whole subject most interestingly and instructively in a book just published, entitled "Locomotive Sparks." A series of careful experiments have been made at the university and on the road, and it is very likely that Prof. Goss' work will be at variance with many time-honored, but unverified, theories. The loss of fuel by cinders and sparks, when tabulated, forms interesting reading. In seven tests the ratio of total weights of cinders and sparks to weight of coal fired varied from .043 to .138, but when it comes to the heating value of this matter thrown from the stack or retained in the front end, we are told that under ordinary working conditions more than 13 per cent. of the fuel which passes the furnace door may completely pass the heating surface of the boiler unconsumed, and this figure may even go up to 20 per cent. if the rate of combustion is sufficiently increased. There is no doubt that the weight of cinders thrown from the stack is greatly in excess of that retained in the smokebox; in fact, modern practice aims at a self-cleaning front end. The book is full of interesting points, which are often not so much not known as overlooked, and it is satisfactory to see them duly placed in order. The conclusion concerning the distribution of sparks in a stack is shown graphically. They follow most readily those portions of the stream issuing from a stack which have the lowest velocity. One may see the same thing when watching the flow of water in a brook; leaves and small twigs will more often hug the shore, where friction along the banks decreases the velocity of water on each side.

In summarizing the results of tests made beside the track of the Lake Erie & Western Railroad, at a point about halfway up a steep grade, Prof. Goss says the greatest number of sparks fell at from 35 to 150 feet from the center of the track, the pans from 15 to 20 feet away usually caught fewest sparks, and no scorching of the cotton which lined the pans was in any case observed. It may be stated that the tests were made in April and May, when there is a certain amount of moisture in the air. Beyond 125 feet the sparks were of such a character as to preclude the possibility of causing fire. In March preceding the tests, when a light crust of snow covered the ground, it was possible to trace evidence of dust from passing engines 800 feet from the track. It might here be mentioned that the "output" of the stack contains a certain percentage of pure ash.

In the matter of "throwing fire," Prof. Goss gives tables showing the distance to which sparks and cinders may be blown when falling from different heights with winds of varying velocities, and also when projected vertically from the assumed height of the stack, 15 feet. In these tables the acceleration due to gravity is taken, as is usual in mathematical calculations, at 32.2 feet per second. This is the true acceleration if a body falls in vacuo. As a matter of fact, the sparks and cinders fall through, and are retarded in, the atmosphere, therefore, by a very ingenious series of laboratory experiments on falling cinders, a new and approximately correct value was worked out. As mathematicians would probably say, Prof. Goss' new "g" fits the locomotive cinder problem more closely than the theoretically correct value. This value is given as 22.72. Based upon this new factor, the two tables previously given are re-stated, and sparks and cinders travel further afield, but even with this allowance for slower falling, the cinders, under the calculated effect of wind, do not appear to go to any extraordinary distance. In fact, the largest individual specimens of cinders were found, in actual practice, within a distance of 100 feet from the track. This practically fixes the danger line, and further, the motion of the train itself may, and no doubt does, often modify or neutralize the action of the wind.

This study of the subject is of great value to those interested in the details of locomotive operation, or who love experimental science for its own sake, but counsellors-at-law, called upon to defend a railway company on the charge of having thrown sparks capable of starting a conflagration, will find much matter within the pages of this little book to lay before the judge and the "twelve good men and true." The book is published by John Wiley & Sons, 43 East Nineteenth street, New York. Price, $2.00.

APPROXIMATE FORMULA FOR THE WEIGHT OF WATER IN LOCOMOTIVE BOILERS.

The following formula will give approximately the weight of two gauges of hot water in a locomotive boiler:

Weight in lbs. $= (ad^2 - bt)\ 1 + cfk$, where

a = .0227

b = .0991

c = .653 for narrow fireboxes, say 40 ins. wide.

c = .706 for wide fireboxes, say 75 ins. wide.

c = .976 for very wide fireboxes, say 100 ins. wide.

d = the inside diameter in inches of first ring of straight boilers, or the average of the inside diameters of the smallest and largest courses of other types.

t = the number of 2-in. tubes; for other sizes multiply the number by the square of the diameter divided by four.

l = the length in inches of the tubes over the tube-sheets.

f = the length in inches of the firebox, at the bottom, inside.

k = the depth in inches of the firebox, at back.

This, as all other simple formulæ for finding weight of water in a boiler, is only approximate, and is not intended to take the place of a careful calculation based on the boiler drawing, but is a ready means of forming an opinion as to the weight of water from the specification before the drawings have been laid down.—George F. Summers, in the "Railroad Gazette."

METALLIC PACKING FAILURES.

A prominent superintendent of motive power is reported to have said that he thought the leakages through piston rod and valve stem packing were nearly as great in volume as the steam that went up the stack. This humorous exaggeration, however, serves to emphasize the fact, true of other things as well as steam, that small leaks will in the aggregate amount to very serious losses. In discussing the Master Mechanics' committee report, last year, on what is the most promising direction in which to effect a reduction in locomotive fuel consumption, Professor Goss, speaking of steam pumps, said that he had found leakage losses of steam to be, in some cases, 2 per cent. and in others 5 per cent., and this, he said, suggests the probability that the steam leaks from a locomotive, even in good condition, result in losses which are too great to be overlooked in any close analysis of the subject.

There is no doubt that it is through the packing of valve stems and piston rods that a good deal of locomotive steam leakage takes place, but like the comparison recently made between a car bolster failure and a drawgear failure, the former does not put the car out of service and is thus, in many instances, neglected. A packing failure is not as serious on the road as an airbrake failure, and does not compel attention in the same way. The packing failure is none the less serious, however, though the results are economic loss rather than operating delay. This may account for the fact that packing is often subjected to treatment which, bringing its natural result, would hardly be described by our M. C. B. friends as "failure under fair usage."

Some of the common causes of failure of packing may be that the babbitt rings are made entirely too hard. In the use of this form of packing, the principle of the "flow of metal" must be relied upon almost entirely to secure good results. Often, it is found, the vibrating cups are elliptical, and so bear unevenly upon the rings. In making repairs the ground ball joints may not be examined as carefully as they should be, and that brings us to the point of cost. In instituting piece work prices for such work, care should be taken not to produce conditions which in practice work out so that it is to the advantage of a workman simply to renew a set of rings, when leakage is reported, rather than to look for the real cause.

Sometimes leaks from cylinder heads, steam chest joints, relief valves, etc., if inaccurately reported by enginemen as packing troubles, may lead to much more being charged against this item of engine maintenance than should be. Injudicious cutting of packing rings, and bad workmanship, in the matter of repairs, may also run up a bill against the otherwise innocent packing, which a court of equity would in fairness be compelled to rule out. There have been packing failures noted on engines just turned out of the repair shop. Such failures have, in specific cases, been traced to the fact that piston or valve rods have been allowed to "knock about," so to speak, on the shop floor, while other work was in progress. It is, however, safe to say that manufacturers of metallic packing would be at all times most ready to instruct railroad employees as to the care of and the manufacture of repair parts.

One large road, remembering the days when the engineer did his own work, was recently reported as going back to the use of hemp packing, on account of trouble with metallic packing. Steam pressures are higher and temperatures higher in steam chests and cylinders nowadays, and the attempt had to be abandoned after a trial of a week.

A good quality of metallic packing, properly applied, should make at least 5,000 miles per set of rings, but here again the "fair usage" idea is essential. The rods must be finished perfectly true, preferably by grinding on a rigid machine, and they must be adequately lubricated. Furthermore, excessive wear must not be allowed to destroy the close fit necessary for the best results. It has been noticed in some instances that a road having trouble with one brand of metallic packing will apply another with very good results for a time, but eventually the second gives no better results than the first, owing, it is claimed, to want of due care and watchfulness.

A very great saving would probably be effected if metallic packing, when not bought directly from the manufacturer, was made in some one shop on the system. This would insure uniformity of quality and workmanship. With all such improvements it is, however, always necessary to educate those who make and those who use the shop product. It may be that, for a time at least, the services of a specialist in this line would produce good results. There is no mystery connected with the efficient maintenance of metallic packing. If it is not closely looked after it will not do its work properly, any more than will any other mechanical contrivance. At least, the packing should all be made at one point and distributed to the various storehouses.

Why is it that the same packing which runs for from two to five years on the shop engine will last perhaps only a week on a locomotive? Of course, dust and dirt have some bearing on this, but it does not explain such a difference. The solution of the difficulty is to either buy the repair parts from the manufacturers or appoint a specialist to have charge of the entire packing question, and one well prepared for his duties by studying the subject at the works of the manufacturers as well as on the road. If this matter is taken up systematically it ought to be easy to save $1,000 per month on a road having 1,000 locomotives. We have figures from actual service to substantiate this statement.

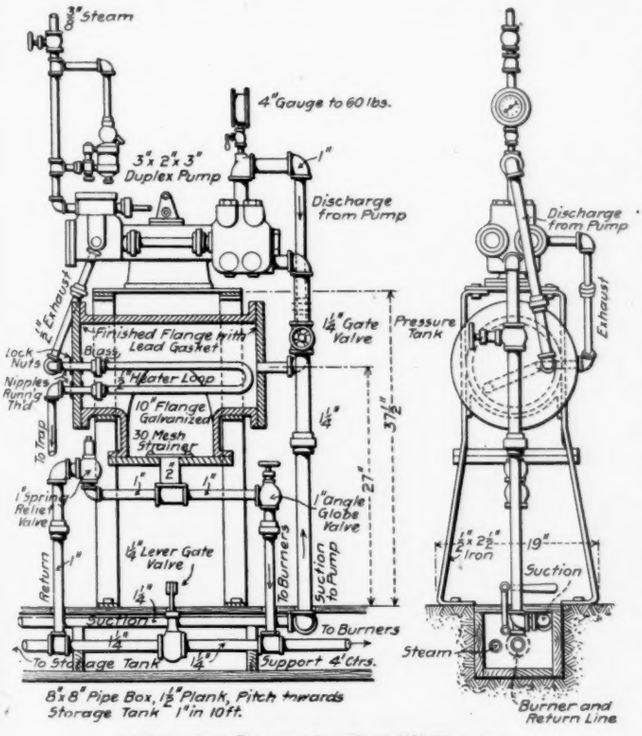
THE STEAM TURBINE.

The steam turbine, in gaining its position in modern engineering practice, is not so much an example of retrograde evolution, but is, what Darwin would have called a "reversion to original type," it being the oldest form of steam motor known. The advantages claimed for the type installed in the Hartford, Conn., power-house are that it occupies about half the space required by a reciprocating engine of equal capacity. Wear is minimized by its having only two bearings. It has a lower fuel consumption, and fewer parts requiring cleaning or repairs. Its first cost is less, and being coupled directly to the shaft, no power is lost in belting or gearing. In order to prevent vibration, running at the high speed it does, the bearings are made of a number of concentric rings of brass fitted loosely, one within the other, the annular spaces between them being filled with oil. This forms a sort of self-centering cushion which prevents vibration, and assists the shaft to seek its true center while running. This machine is extremely sensitive to the governor, which is of the ordinary ball type, and is adjustable so as to run within a variation of a fraction of 1 per cent., between full load and no load. The Hartford turbine with no load will run for 20 minutes after steam has been shut off. Increased economy in operation generally means greatly increased complexity of parts and a rise in some of the maintenance charges, but this is not true of the turbine. The generator to which this Hartford machine is coupled is rated as a 1,500 killowatt high speed alternator. The turbine is operated with 150 lbs. steam pressure, and running at 1,200 revolutions per minute, should develop about 2,000 h.p. of effective energy. It is interesting to reflect that if the steam turbine is found to be a practical and truly economical substitute for the reciprocating engine, it proves that a vast amount of study and work has been thrown away upon the reciprocating steam engine, which in its highest development is inferior to this more primitive type, in which steam passes directly through the mechanism, and thus, strangely enough, avoids everything for which the mechanical engineer has striven for a century.

A PUMPING SYSTEM FOR FUEL OIL BURNERS.

By William D. Hoffman.

The increasing use of oil as fuel has brought out improved methods of handling and storage. Where the oil must be distributed over considerable distances, the pumping system shown in the accompanying engraving, which was designed by the writer some years ago, has proven an efficient means of supply for any number of oil burners within the range of the pump. The 10-in. T acts as a reservoir for the oil under pressure, the upper part of the T being an air chamber. The openings are closed by blank flanges, and the joint made with a lead gasket. The exhaust from the pump is carried through the coil inside of the T, so as to heat the oil when necessary, and it may be noted that all fuel oil lines should be laid in a box with a steam heating pipe to secure the best results from the fuel when it reaches the burner. The oil is discharged from the reservoir through a 2-in. opening, which



A Pumping System for Fuel Oil Burners.

is reduced by means of a T to two 1-in. branches. One of these branches goes to the burner line, while the other furnishes a relief for surplus oil through the relief valve back to the storage tank. I consider this superior to relieving the surplus oil back into the suction. The burner line is connected to the return line to the storage tank through the lever gate valve shown below the center of the reservoir. Opening this lever gate valve drains the entire system, and also the burner line, back into the storage tanks. In case of accident the stoppage of all burners may be made instantaneous by opening the lever gate valve, and the oil is returned to the storage tanks through the return line. The pump may be set, as shown, on the frame which supports the reservoir, or in any convenient location near the reservoir. The relief valve may be set to open at any desired pressure indicated on the gauge. In cases where the burners are operated at intervals a pump governor operated by the pressure from the reservoir will prevent any decrease of the pressure on the oil. By removing the blank flanges on the T the interior is accessible. A galvanized T is best, as it prevents any leakage through sand holes in casting. This pumping system being made up of simple parts, it may be easily constructed at a low cost.

[Mr. Hoffman's address is 102 Purchase street, Boston, Mass.—Ed.]

VISION, COLOR-SENSE AND HEARING.

The important point in Dr. Charles H. Williams' paper on "Vision, Color-Sense and Hearing," recently read before the Western Railroad Club, is that a man may pass the colored-worsted test, and yet have defective color sense for colored lights at night. He showed that the lantern test, by reason of its different intensities of lights and its smoked glass lenses, approximates closely to actual service conditions. It can be made to show a light which, by size, can be made to represent a switch or signal light at short range or at a distance of 1,500 ft.

The reason why the lantern test is efficient is that it shows whether or not the central portion of the retina of the eye is affected. It is upon this central portion that the rays from a distant object are focused. When the colored object is large enough or when it is near the eye, its image may extend beyond the affected part of the retina and its color will be recognized. When the retinal image is small and falls entirely within the defective central area, the color is easily mistaken. This central defect is frequently found in the case of men who use tobacco to excess, especially when combined with alcohol.

Test cards on the market, for ascertaining acuteness of vision, were found to vary so much in size of letters, that special cards were prepared in accordance with rules laid down by Prof. Snellen. These cards are published by the Rand-Avery Supply Company, of Boston. An example was given of a man who had learned the smallest line of letters, and apparently read it easily. The examiner discovered the fraud by unexpectedly asking him to read the next larger line. The way to avoid such a difficulty is by having three cards printed, with a different arrangement of letters on each, for each of the given distances. Then if the letters on all three cards have been committed to memory, the subject for examination cannot tell which of the cards will be held up, and he cannot read them unless he can see them.

The hearing test requires that a man shall hear with one ear at a time, words spoken in an ordinary conversational tone at a distance of 20 ft., and be able to count the ticks of a ratchet acoumeter.

The use of glasses is to be permitted for reading train orders, but they are not otherwise to be worn on duty, except in the case of telegraph operators, station agents, section foremen and crossing flagmen. The paper contains the rules which are in force on the New York, New Haven & Hartford, with a discussion of each rule. These rules have been in use for three years.

Speaking of keeping hard times away, a Pullman official recently said that his company was working with its entire production for this year sold, and at the rate of one thousand freight cars and one hundred passenger cars per month. The company employed six thousand men, and the full capacity of the Pullman plant was now being tested. This unexampled prosperity was not the exclusive experience of the Pullman Company; all the big, leading industries of America are feeling it too, and as no trade breaks off suddenly, he thought that from forty to seventy-five per cent. of present prosperity would continue during 1903, and that would certainly keep hard times away for at least another complete year.

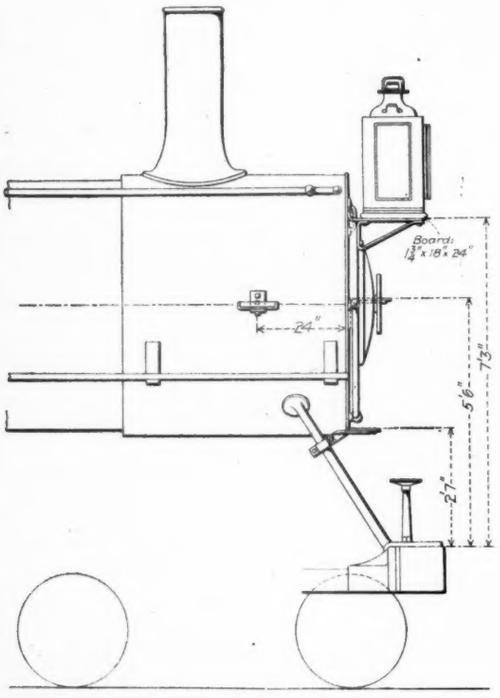
HOW TO KNOW STEEL.

I have often seen a machinist pick up a bar of metal covered with rust and dirt and wonder whether it was tool steel or machine steel. Now, there are a number of means of finding this out, but the emery wheel test, while not a particularly refined method (it will not tell you everything about a steel) is as quick and handy as any. To test a piece, touch it lightly against a dry emery wheel and observe the sparks as they strike the frame of the machine. A high-carbon steel gives a spark which apparently bursts into a brilliant star-like point of light when it strikes against anything. The spark from a low-carbon steel is, on the contrary, merely a dull, incandescent particle. All the air-hardening steels I have noticed give a very red spark. By the way, some air-hardening steels can be greatly improved by heating to a bright red and quenching in oil. In grinding after this care should be taken not to start the color.—American Machinist.

LOW LOCOMOTIVE HEADLIGHTS.

Chicago & Northwestern Railway.

Headlights are often placed on top of the smokeboxes of locomotives, where they are frequently subjected to high temperature, and with the gradual increase in the length of boilers they give a cramped appearance when placed close up to the stack. On several roads the location has been changed, with advantage in the condition of the headlight, and in the



Low Headlights on Smokebox Fronts.
Chicago & Northwestern Railway.

appearance of the engine. The headlights on the large engines on the Chicago & Northwestern have been changed in accordance with the accompanying sketch, which shows the construction of the brackets and the steps. This location brings the light down nearer to the rails, which is important in the case of large engines.

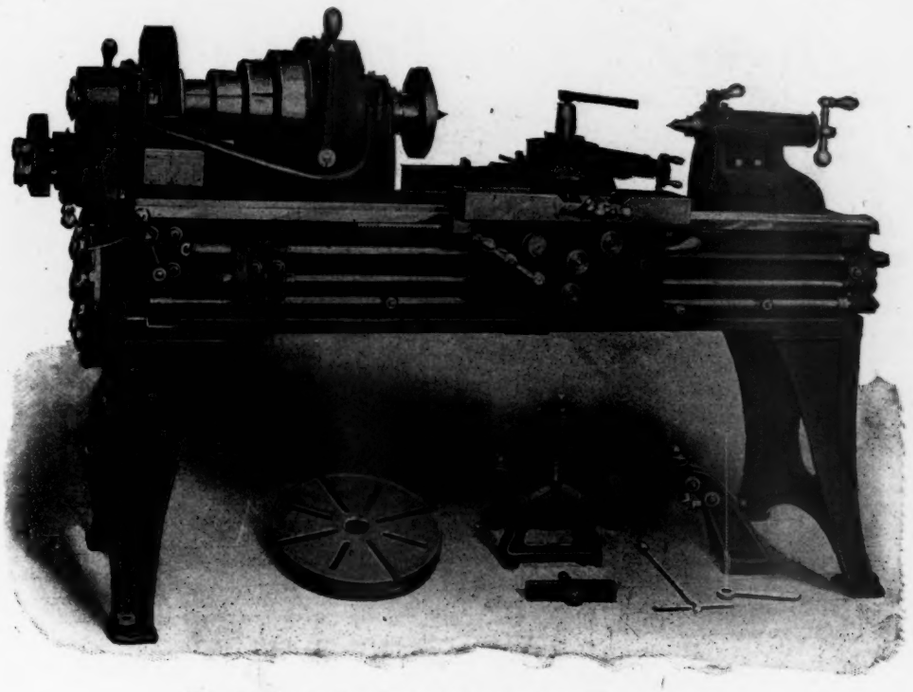
TEAM WORK IN COMMERCIAL ENGINEERING.

"The future lies in team work," said Mr. Charles Kirchhoff, in an address recently delivered to the students of Sibley College. This is true, as he points out, because "our industries are destined to be controlled more and more by larger units, the modern consolidations." In this most suggestive address on the Commercial Side of Engineering, the editor of the "Iron Age" lays down the principle that it is by the achievement of commercial results, rather than simply the attainment of technical excellence, that the work of the engineer must be judged, and though the engineer may not at first look with entire satisfaction on such an idea, it is, however, fair and equitable. It is true that a clever sale or a timely purchase made by the business manager of a large industry may make a spectacular appeal to the average stockholder, but a small, cost-reducing technical improvement made by the engineer is a saving which, though it may attract less outside attention, is not of merely passing value, but is a positive advantage for all time.

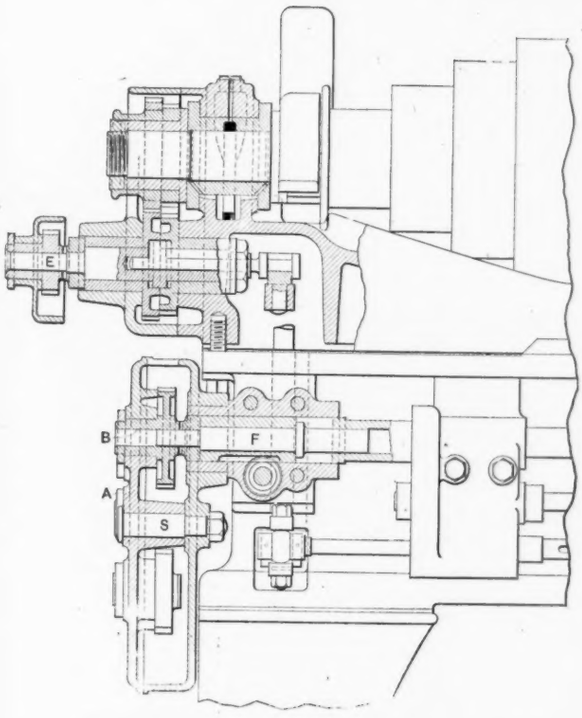
The system of the United States Steel Corporation is taken as an example. The object of that corporation, while it endeavors to eliminate competition outside, fosters competition and rivalry between its various plants. A committee is formed among the managers of special branches of steel making in the different works. Each committee meets to study costs, methods of comparison, etc., and a record of the conference is kept. This system broadens the views of those upon whom it operates, and its educational value is beyond question. Every special appliance, every minor manufacturing kink, once jealously guarded, is now the property of all. In fact, there is a constant interchange of all that is best, and a consequent weeding out of faulty or expensive methods. The practical standard of excellence is the average cost of the six best managed plants, and the others are expected to reduce their expenses, with due allowance for circumstances, to conform with this actually attainable cost. In some such way it is possible that good results could be obtained on railways, by the pitting of one division against another in friendly rivalry, but the essence and beauty of the steel corporation system is that the methods and the ideas, and we might almost say the appliances, of each are the common property of all. The system has in it, after all, less of the feeling of hostile competition, but more of the spirit of a team which is learning to play the game together.

In this country those who can afford the luxury have private cars, but English nobility has gone a step further in the case of the Duke of Sutherland, who has a whole train, which was built specially for him at the Wolverton Works of the London & North Western Railway. It contains a large saloon for dining, a private sitting room, berths, luggage spaces, kitchen, pantry and lavatories, the whole connected by a series of handsomely decorated vestibules and corridors. Viewed, even from the outside, the train presents a sufficiently striking appearance, with its dark green enameled panels, picked out with cream and gold. Internally the fittings are of the most elaborate description. The principal saloon has a figured lincrusta roof in white and gold, with side panelling to match. All of the couches and easy chairs are upholstered in green figured tapestry, and the friezes and window curtains are of rich green silk. Velvet pile carpets cover the floors of the principal compartments, and cork linoleum is fitted to the corridors, vestibules, kitchen and lavatories. Electric lighting is used throughout, and there are also electric bells in the attendants' compartments, and electric fans for hot weather. For heating in winter, stoves on the hot-water high-pressure system are provided.

Last year the Lake Shore increased its revenue freight 10 per cent.; mileage of loaded cars 7 per cent. The average load per train increased 16 per cent. and the mileage of freight trains decreased 5 per cent.



New Engine Lathe—Springfield Machine Tool Company.



Section Showing Change Gear Mechanism.

THE "IDEAL" ENGINE LATHE.

With Rapid Gear Changing Attachment.

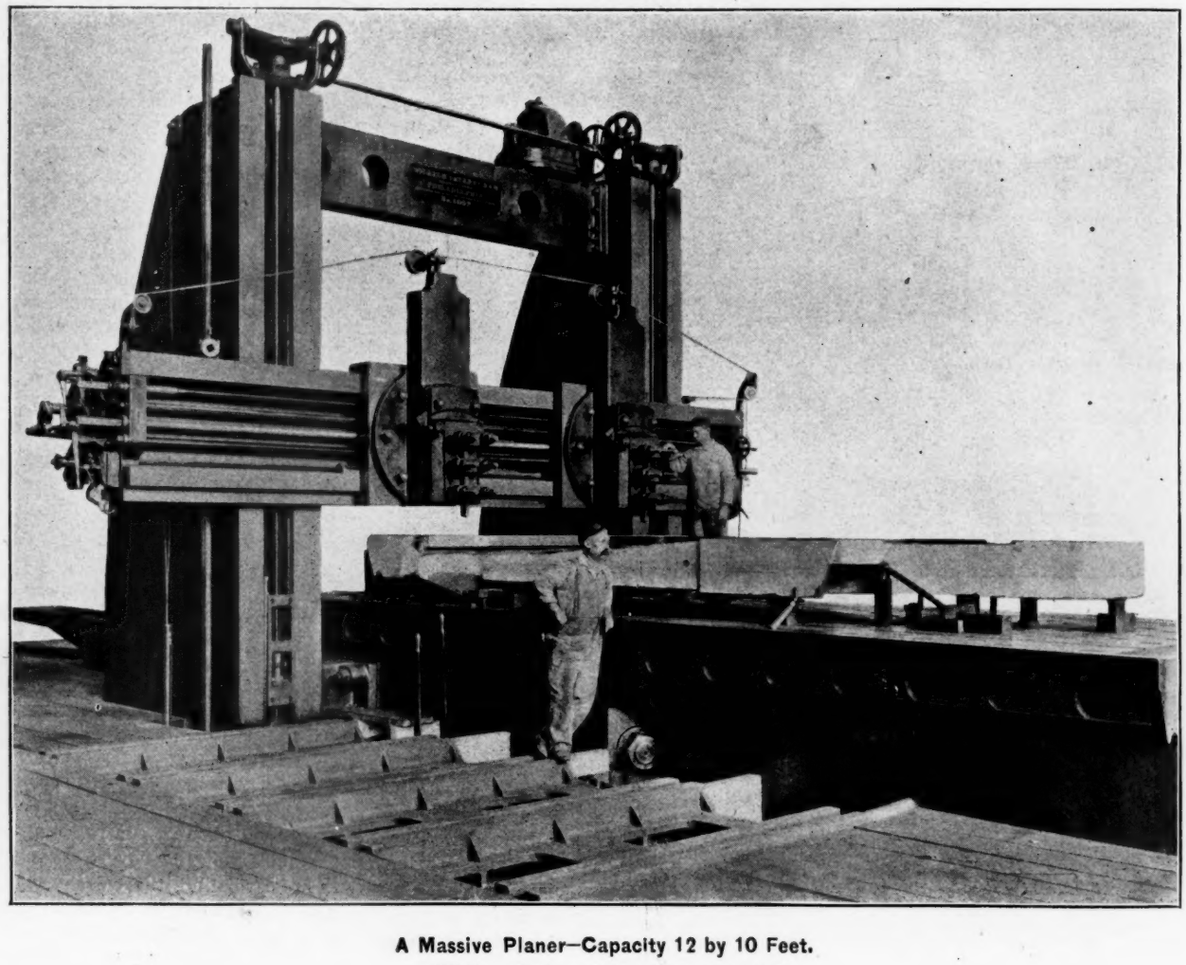
Among the interesting features of this new lathe, built by the Springfield Machine Tool Company, of Springfield, Ohio, is an attachment whereby any change gear may be substituted for any other driving the lead screw without unscrewing binding nuts or touching the gears.

The change gears are mounted in a gear box, shown at the left-hand side of the large engraving, the intermediate and head stock spindle gears being those ordinarily used. The cover of the gear box is rotated about a central stud, and the gears are carried on the inside of the cover, arranged in a circle concentric with the case, and this circle brings the change gears opposite the end of the lead screw by revolving the cover of the case. The small clutch, C, moves a telescopic extension of the lead screw and enters it into a hole in the change gear before the driving clutches between the change gear and the extension come into contact. This device takes the bearing of the change gear upon the extension for its support, and secures the change gear to the lead screw as firmly as if fastened by a nut. In order to change the gear, the cover is revolved until the desired gear is opposite the center of the lead screw extension, when the small clutch is thrown. All of the eight change gears are protected by the case except the top of the one which is in mesh with the intermediate gear.

To give a sufficient range of pitches, a set of three pairs of gears is provided in the headstock to vary the speed of the intermediate gear. These are housed in the gear cases shown at the extreme end of the headstock. These are clutched to their spindles by slipping them on until their clutches engage the spindles, which have clutches with their end sections reduced, as in the case of the lead screw shown at F in the sectional drawing. These gears furnish ratios of from 1 to 1, 2 to 1 and 4 to 1. The last two may be reversed and five speeds may be given to the fixed pinion driving the intermediate gear. The intermediate gear revolves on a fixed stud on a quadrant to which the handle is attached, and is removed from contact by raising the quadrant.

This lathe has a range of threads from 2 to 56 per inch, and a range of turning feeds from 8 to 224 turns per inch, and all the changes for any of these feeds or threads may be made while the lathe is running. The lathe has a reverse motion operated at the carriage, a friction geared head spindle and an automatic stop for screw cutting and turning.

The Magnus Metal Company have moved their New York office from 71 Broadway to 170 Broadway.



A Massive Planer—Capacity 12 by 10 Feet.
William Sellers & Co., Incorporated.

A 12 BY 10 FT. PLANER.

Designed and Built by Wm. Sellers & Co., Incorporated.

The illustration here presented shows an unusually massive and powerful planer, built for the Midvale Steel Co., of Philadelphia. It is designed to take the heaviest cuts on hard steel forgings and has a capacity between housings of 12 ft. and a height of 10 ft., with a table 10 ft. wide and 27 ft. long, having a working travel of 25 ft. There are two saddles on the crossrail and a vertical slide rest on each upright or housing.

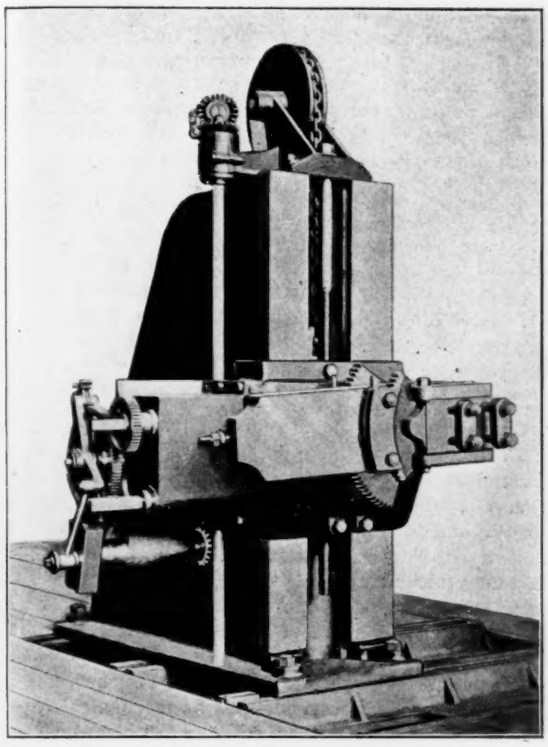
One peculiarity of this planer is that the feeds for each of the four tool holders are independent in direction and amount, each having its own feed motion and crank disc for regulating the amount of feed. To accomplish this, feeding mechanism is mounted on both ends of the crossrail, the two saddles being controlled from opposite ends. Each vertical slide rest carries likewise its own feeding mechanism and all are driven from a common source.

The bed, which is in two pieces, has a vertical depth of 4 ft. 4½ ins. and the ways on the table are flat, 16 ins. wide and 7 ft. from center to center. One bearing only is guided. The table is provided with a steel rack of 3-in. pitch, 18-in. face, operated by a bronze spiral pinion on a 9-in. diagonal shaft. This shaft is driven by a bevel wheel and pinion from a pair of friction clutches operated by a pneumatic cylinder. The action of the stops on the table admits air pressure through either end of the clutch shaft to the proper end of the clamping cylinder, thus causing the alternate engagement and disengagement of the driving and reversing clutches.

The receiving pulley on the machine is 48 x 12 ins. and power is transmitted from the pulley by suitable gearing to the clutches, the train to the forward motion clutch being provided with change gears to give a variety of cutting speeds, the speed of reverse remaining constant. It is thus possible to obtain with ease the best results on materials of all kinds, from soft cast iron to high carbon steel.

Air pressure is also employed to move the stops in the escapement train which operates the feed motions. It is thus seen that the table does no work in the act of reversing, except to move the small air valves which control the escapement and driving cylinders. The tool clamps on the crosshead are arranged to take tool bars 6 ins. square and the parts are so massive that it is necessary to provide means of handling them by power; two series motors are therefore mounted on the projecting ends of the crossrail, which is 42 ins. deep and nearly 23 ft. long, and by these motors the saddles on the crosshead and the slides on the saddles can be moved to any desired point at a rapid rate and with great accuracy. The crosshead itself is lifted by a 10-h.p. motor mounted on top of one of the housings, provided with an electric brake to prevent the load from running down. The vertical slide rests are counterbalanced, have power feed on the face of the upright and a power crossfeed which may be either horizontal or inclined through a wide angle above and below the horizontal.

The lubrication of the massive table is a matter of great importance in a machine of this kind, and it is here accomplished by a centrifugal pump forcing oil over the bearings under the table, the arrangement of oil grooves being such as to insure a thorough distribution over the entire surface. Catch troughs are arranged to extend beyond the furthest



Auxilary Upright for Large Sellers Planer.

overhang of the bed and the oil is led back through a strainer to the pump tank.

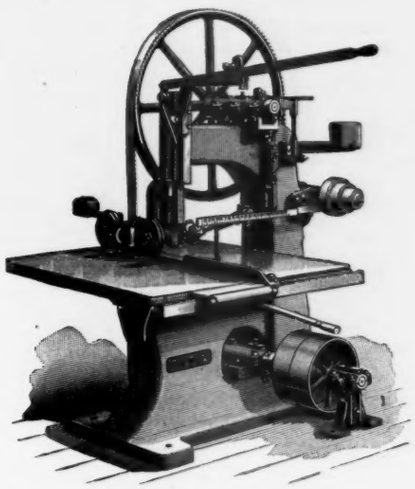
The housings are of box construction and measure 30 ins. wide on the face and 19½ ft. high, and nearly 10 ft. deep in the direction of the length of the bed. It is said that the method of driving is peculiarly successful, it being possible to stop and start the table by hand at will and to reverse promptly, so that the table may be used with a very short stroke.

The illustration does not show the vertical slide rests on the uprights, one being obscured by the intervening bed and table and the other having been removed for attachment to the auxiliary upright shown in a separate illustration. This upright is used in finishing work too wide to pass between the housings and is carried upon the floor plate shown in the illustration, power for feed being derived from the square shaft on the left hand housing for actuating the feed on the auxiliary upright.

The spraying machine saves time but uses more paint than the brush, was the general verdict of the Southern and Southwestern Railway Club, at a recent meeting where the question of relative cost was discussed. It was claimed that the sprayed car presented a rougher surface than the brush painted car, but if this is the case, it is offset by the fact that sprayed paint finds its way into places not reached by the brush, and the covering is fully as durable. A long nozzle was advocated, in order to prevent the operator inhaling a dangerous amount of spray. The weight of the machine is obviously a drawback, and causes loss of time by reason of the operator needing to rest occasionally. A truck carrying a supply reservoir has been found convenient, but trouble has been experienced by the eating out of the supply hose. According to one report, the advent of the machine had the effect of making the hand painters work faster. Opinion, on the whole, was about evenly divided as to the relative merits of the two systems. Further experience and more perfect construction of the machine, however, was thought likely to soon gain for it a permanent position in every railroad paint shop.

NEW SELF-FEED BAND RIP SAW.

The J. A. Fay & Egan Company, of Cincinnati, Ohio, have just put upon the market a patent self-feed band rip saw. The illustration shows that company's No. 1 size. It will rip wood from 1 to 10 inches thick with equal facility and without the blades being changed. All adjustments can be made easily, quickly and accurately. It is safer to operate than is a circular saw, as there is no danger of the stock being thrown back to strike the operator. The blade of the saw is very thin, and the small kerf removed in ripping is a point of excellence which cannot fail to be appreciated by users of fine lumber. The straining device used in connection with the knife edge balance insures, under ordinary circumstances, a perfect and uniform tension on the saw blade. This is an important feature, as it tends to prolong the life of the blade. The feed arrangement is very powerful. The feeding-in and feeding-out rolls are placed close together, so that short stock may be worked to advantage. Where flooring is made in large quantities a machine can be supplied with "live rolls"; these will return the material to the operator for another cut, thus saving much time and attention. The company, whose offices



A New Self-Feed Band Rip Saw.

are at 409-429 West Front street, Cincinnati, Ohio, will give further information, and on request will send free a new 450-page catalogue showing every machine made in the works.

Grinding, as a machine operation, has passed the experimental stage, and now takes its place as a recognized mechanical operation in railroad or other shops, and can be made to yield most economical results. For good cylindrical grinding, stable machines which will resist vibration and are capable of successfully dealing with a large stream of water, are necessary. For surface grinding where accuracy is not of much importance, grinders will be found in a great many cases much more economical than hand polishing, as one man can keep four or five machines in operation. The most striking example, however, is in cylindrical grinding. Work was recently done, says "Engineering," on a machine capable of finishing parts up to 18 ins. in diameter and up to 8 ft. long, carrying a 24-in. grinding wheel with 2-in. face. It is on record that a 4-in. shaft, 3 ft. long, can be finished in six minutes. The shaft was first rough-turned, with a 12-per-inch feed. It was left 0.01 in. above size at the bottom of the tool marks. Parts up to 7 ins. in diameter are rapidly finished, with a limit of variation of 0.001 in. With such facts before them, manufacturers and shop superintendents can hardly afford to overlook grinding as an important "cost reducer."

PERSONALS.

Mr. C. A. Goodnow has resigned as general superintendent of the Chicago, Milwaukee & St. Paul, to become general manager of the Chicago, Rock Island & Pacific.

Mr. A. O. Berry has been appointed mechanical engineer of the Boston & Albany, with headquarters in Boston. He is a graduate of Cornell University.

Mr. W. J. McQueen has been appointed master mechanic of the Hudson, Harlem and Putnam divisions of the New York Central to succeed Mr. S. W. Simonds, who has resigned.

Mr. John Purcell, master mechanic of the Santa Fe at Fort Madison, Iowa, has been promoted to the position of superintendent of the Topeka shops.

Mr. Charles Linstrom has resigned as mechanical engineer of the Chicago & Alton to accept the position of chief engineer of the Pressed Steel Car Company.

Mr. H. T. Herr has resigned as master mechanic of the Chicago Great Western at St. Paul to become master mechanic of the Santa Fe at Fort Madison, Iowa, to succeed Mr. John Purcell, promoted.

Mr. A. J. Cota has been transferred from the position of master mechanic of the Burlington at Beardstown, Ill., to succeed Mr. R. D. Smith as master mechanic at Chicago. Mr. Cota is succeeded at Beardstown by Mr. Taylor L. Smith.

Mr. G. R. Joughins, who recently resigned as mechanical superintendent of the Intercolonial, of Canada, has been appointed mechanical superintendent of the Pacific Coast lines of the Santa Fe at San Bernardino, Cal., succeeding Mr. G. W. Smith, resigned.

Mr. George Gibbs has been appointed the sixth member of the Pennsylvania Railroad Commission in connection with the terminal developments in New York City and on Long Island. Mr. Gibbs will have charge of the mechanical and electrical engineering problems, a work for which he is specially well fitted.

Mr. J. C. Whitridge has resigned from the editorial staff of the "Railroad Gazette," to accept the position of assistant to the general manager of the Buckeye Malleable Iron & Coupler Company, at Columbus, Ohio. Mr. Whitridge has been connected with the "Railroad Gazette" for the past six years as associate editor.

Mr. C. H. Quereau has resigned as assistant superintendent of motive power of the Denver & Rio Grande to accept the position of superintendent of shops of the New York Central at West Albany, where he will have charge of both locomotive and car shops. Mr. Quereau will be a valuable addition to the New York Central staff. He has had a good experience and thorough preparation for his new position.

Mr. W. E. Symons has resigned as superintendent of motive power of the Plant System of railways and will sail for France in a few days to make a study of recent locomotive practice there and in other continental countries. He has been at the head of the motive power department of the Plant System five years. Previous to that he represented the Galena Oil Company here and abroad, and for five years held the position of master mechanic of the Santa Fe at Raton, New Mexico, and at Argentine, Kansas.

Mr. R. D. Smith, who has for many years been identified with the motive power department of the Chicago, Burlington & Quincy, has been appointed superintendent of motive power of the Burlington & Missouri River. Mr. Smith was born in New York City in 1854, educated at Albany, N. Y., and entered railroad service in 1872 on the Albany & Susquehanna as a machinist apprentice. He served as machinist, fireman and locomotive engineer on the Kansas City, St. Joseph & Council Bluffs until he went to the Burlington as foreman in the Aurora shops in 1881. In 1885 he went to Chicago as general foreman of car and locomotive repairs and in 1888 was made master mechanic at Chicago, which position he has held to date.

Mr. Charles A. Seley has resigned as mechanical engineer of the Norfolk & Western, to accept a position with the same title on the Chicago, Rock Island & Pacific. He was born in Wapella, Ill., in 1856, and was educated in the schools of Peoria, Ill., and St. Paul, Minn. Prior to 1885 he had twelve years' shop experience, drawing office and engineering work, and in that year was appointed a member of the State Board of Boiler Inspectors of Minnesota, serving two years. After this he entered the service of the St. Paul & Duluth in the drawing office, and next had charge of the Great Northern drawing office for four years. In 1892 he resigned, and spent two years in the machinery business as mechanical engineer. In 1895 he took charge of the drawing office of the Chicago Great Western, serving four years, and went to the Norfolk & Western as mechanical engineer in 1899. This position he now leaves to take up his work with the Rock Island. Mr. Seley is a self-educated mechanical engineer, who has outstripped many men who have enjoyed superior advantages. He has made an enviable reputation as an intelligent, careful designer and painstaking, reliable investigator, qualities which are needed in every motive power department.

The annex to the Mutual Life Insurance Building in New York is in several respects the most remarkable structure in the world. The engineering work done is worthy of special mention. The cellar floor is 55 ft. below the sidewalk and 35 ft. below the line of standing water. The foundations rest on bed rock 100 ft. below the surface of the ground. Above the sidewalk the annex is eight stories high on Cedar street, while its towers are sixteen stories high in Liberty street. The building at 32 Liberty street, one wall of which had to be underpinned, is the highest building ever so treated. The work was rendered more difficult, as the ground floor was filled with safes and vaults of a safe deposit company, and a settlement of one-sixteenth of an inch would have stopped the working of the locks. The filling of the spaces between the caissons with red clay was ingeniously performed. It was done by sinking a 3-in. pipe between the caissons by means of a water jet, dropping cores of clay into the pipe, and forcing the clay out by dropping a heavy steel bar upon it, the pipe having been drawn up the depth of the clay core.

In Great Britain the question of "standards" was recently taken up by the Engineering Standards Committee. The question took the form of a discussion as to whether it was desirable to standardize locomotives, and, if so, should it be the standardization of general design or of the component parts only. Standardization was unanimously affirmed as a principle, though it was shown that the standardization of general design would not be of benefit to the English lines, but would be of great importance to the Indian and Colonial railways, and that this standardization would effect an enormous saving of time and money. The question of standard specifications, defining the quality of the materials used in locomotive construction, was also discussed.

BOOKS AND PAMPHLETS.

"The Engineering Index for Five Years, 1896-1900." Edited by Henry Harrison Suplee. Large octavo, 1,030 pages. New York and London: "The Engineering Magazine." 1901. $7.50.

"Next to knowing a thing comes the faculty of knowing where to look for it, and, indeed, it is a question as to which form of knowledge should take precedence." This quotation from the preface of this work represents its place in the working equipment of an engineer. In it are 40,000 entries concerning important articles from 200 periodicals devoted to engineering and manufacturing. These are selected with discriminating care and are entered with sufficient information to indicate the character and scope of the articles. The arrangement is alphabetical, as to "catch words," and a careful test of the cross indexing shows it to be conscientiously carried out. It is a great work for a great purpose. It renders available the enormous volume of periodical literature with a scope vastly beyond the possibilities of the widest reader. It is a directory to much which an engineer never sees and has not time to read, as well as to that which has come to his attention. The reviewer considers this the most important book of the time to the engineer, contractor, attorney and student. This is not a time for technical books. Progress is far too rapid for any record other than that of periodical publications. This index virtually collects the periodical literature of five years into one convenient book, the pages of which may be consulted on the shelves of any good engineering library. This is the third volume of the Engineering Index, which was undertaken originally by Professor Johnson. It is enlarged and improved in every way, and is particularly rich in entries from foreign publications, in railroad subjects and particularly with reference to locomotives. Mr. Suplee and the "Engineering Magazine" should have every encouragement to continue this valuable service.

"Velocity Diagrams: Their Construction and Their Uses." By Chas. W. MacCord, A. M., Sc. D., Professor of Mechanical Drawing, Stevens Institute of Technology. 8vo., 116 pp., 83 illustrations. John Wiley & Sons, 43 East Nineteenth street, New York. Price $1.50.

This treatise is in effect an abstract of a series of lectures given to the author's classes. It explains the principles of the more common and convenient graphic processes of determining at any given instant the direction and velocity of the motion of a point, whether the motion be constant or variable. Extensive use is made of the Reuleaux method of instantaneous centers, and some very interesting results are obtained by the use of Roberval's method of drawing a tangent to a curve. The treatment is clear and concise. Graphical methods are employed with simple mathematical proofs which permit anyone who may be interested in the subject to study the various problems without the aid of an instructor.

"Railway Management and Operation."—Mr. A. W. Sullivan, assistant second vice-president of the Illinois Central Railroad, recently delivered an address before the students of the College of Commerce and Administration, in the University of Chicago, in which he set forth what a railroad really is, and explained the method of its management and operation. This address has now been issued in pamphlet form for distribution. The definition of the various departments, with the scope of each, occupies the opening pages, together with a statement of the duties of the officers. The whole harmonious inter-relationship of each of the parts in the organization of a modern railway is dealt with in detail. Mr. Sullivan gives a bird's eye view of railway management and operation which is most useful to a young man entering the service. One learns from such a comprehensive picture many of the details which men, closely occupied in departmental routine, never gain outside of the department in which they are themselves employed.

Some quaint reminiscences of the London & North Western Railway appear in a paper recently read by Mr. C. E. Stretton at the Railway Club of that road. It appears that this railway was formed by the union of the London & Birmingham, the Grand Junction, and the Manchester & Birmingham lines. The cause which brought them together was principally the erection of the Birmingham viaduct. Seeing their danger, being narrow gauge lines themselves, they united to keep the 7-foot gauge lines south and west of Birmingham. At that time the London & North Western had 257 locomotives, and was and is the largest joint stock railway corporation in the world. In December, 1846, it was possible for a passenger to leave Euston by the Scotch express at 10 A. M. and arrive at Carlisle at 9.55 P. M., but he had to continue his journey to Edinburgh by stage coaches.

A handsome souvenir mailing card, containing 8 half-tones, showing as many steel structures of great strength and pleasing architectural effect, has been issued by the Joseph Dixon Crucible Company, of Jersey City, N. J. It will be sent to any address on request, and is expected to be of interest to constructing engineers, architects and others. The Dixon Silica-Graphite Paint used to protect this metal construction from rust, has been used extensively in this country, and also in Mexico, Australia, China, Japan, the West Indies and the Philippine Islands. It has proved its protective and wearing qualities in all climates.

The U. & W. Piston Air Drill is illustrated in the catalogue of the Columbus Pneumatic Tool Company. This pneumatic tool is designed for "close work," or where holes have to be drilled where the room to get at them is limited. It is made entirely of steel, with frame and cylinders of high grade bronze. It is a slow speed tool, and so is not likely to burn the drills. It is stated that with 100 lbs. air pressure the No. 2 size will drill a 2-in. hole in steel at the rate of 1 in. in 4 minutes. The tool weighs 25 lbs., and has roller bearings throughout, with one exception, and is consequently economical with oil. The catalogue shows in 8 half tones the variety of tight places in which it can be successfully and economically operated. The address of the company is 123 Liberty street, New York, or Columbus, Ohio. The catalogue will be furnished on application.

In the Jones National Fence Company's catalogue concerning "up-to-date" metallic sheeting and fireproof material, which has just come to hand, we find a form of construction which might be applicable to station platforms or shop floors. It is described as the "flat arch showing carrying rods and metallic netting on wood construction." The floor, in this method, is carried on longitudinal wooden stringers or joists of ample size. Upon these stringers the metallic netting and carrying rods are placed, with the under side protected by plaster. Upon the upper side of this netting a substantial layer of concrete is placed, almost as deep as the wooden stringers themselves. Resting upon the concrete is the floor proper, which may be composed of wood, tile or cement, of any depth required. This form of construction has every appearance of being solid, and thoroughly fireproof. A catalogue will be sent to those interested by addressing the Jones National Fence Company, of Columbus, Ohio.

The B. F. Sturtevant Company, Boston, Mass., give some interesting and surprising figures in a neat little pocket publication, "Bulletin 46, on Mechanical Draft, What It Is and What It Does." We are told that when that company remodeled its works at Jamaica Plain, a new location was chosen for the boiler plant, and a chimney was not built. Instead, a Sturtevant, engine-driven, induced system fan with water-cooled bearings, was installed above the battery of boilers, thus occupying no floor space. The engine for operating the fan is automatically controlled by the steam pressure of the boilers, and there is practically no smoke. Fuel of a cheaper grade was consequently used, and the saving on fuel in a year was greater than the first cost of the mechanical draft plant; and the cost of the apparatus for producing this induced draft was less than half what it would have taken to build a chimney. The power was increased 103 per cent. above the rating, with an evaporation of 10.75 lbs. of water from and at 212° F. per pound of coal. The Sturtevant Company will forward the bulletin to applicants.

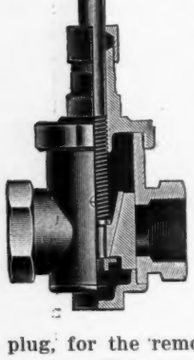
Steel car design on the Norfolk & Western has been pursued systematically and effectively. In this issue a 40-ton steel frame box car is added to the number of successful designs. Of its success there seems to be no doubt, and these cars constitute a series, all worked out by the motive power department of the road. This is a record to be proud of.

FALLS HOLLOW STAYBOLT.

The Engineering Department of McGill University, Montreal, Canada, has recently made a test of Falls Hollow Staybolt iron at the request of the Falls Hollow Staybolt Company, of Cuyahoga Falls, Ohio. The result of the test showed the ultimate strength of the iron to be 49,300 lbs.; the yield point, 32,000 lbs.; an elongation of 31.20 per cent. was observed, with a reduction of area of 45.7 per cent. Concerning these stays, Prof. J. W. Shepherd, of the University of Chicago, says: "A proper distribution of hollow staybolts, in a properly drafted locomotive, burning bituminous coal, will undoubtedly lessen the black smoke and be economical as far as fuel is concerned, because of the better mixing of the oxygen of the air with some of the volatile gases of the coal, which would otherwise partly or wholly escape combustion."

THE NEW ASHTON BLOW-OFF VALVE.

This blow-off valve, recently perfected and placed on the market by the Ashton Valve Company, of Boston, has met with a reception which confirms the claims made for it. Its special features are ease of operation in both opening and closing, and a straight passageway free from obstruction when the valve is opened. Instead of depending upon the boiler pressure to keep it tight, this valve is made with a split plug, which is expanded to make a tight joint by the final movement in closing. In opening, the first movement releases the wedge and loosens the plug. It then opens, without friction against the seat. In fact, the pressure carries the valve away from the seat. At the bottom of the casing is a removable plug, for the removal of anything which may collect in the casing. This valve is claimed to be perfectly tight when closed, and it is said to be very durable.



EQUIPMENT AND MANUFACTURING NOTES.

The Railroad Supply Company, and the Q. & C. Company, will operate separately after July 1, as they did before the union of interests was effected in January, 1901.

Mr. J. D. Hurley, formerly vice-president and general manager of the Standard Pneumatic Tool Company, has been appointed manager of the Chicago Pneumatic Tool Company, with headquarters in Chicago.

Mr. E. N. Hurley, formerly president of the Standard Pneumatic Tool Company, now a director in the Chicago Pneumatic Tool Company, has sailed for London to meet the president, J. W. Duntley, and complete arrangements for the purchase of the International Pneumatic Tool Company, of London. Messrs. C. E. Walker and C. Booth are also in Europe in the interest of the Chicago company. The popularity of pnuematic tools abroad is indicated in an order recently received for 150 pneumatic tools from a single European concern.

The newly organized Standard Steel Car Company, of which Mr. John M. Hansen, late chief engineer of the Pressed Steel Car Company, is president, will be located in Butler, Pa. Contracts for buildings and machinery have been let. The United States Steel Corporation will deliver 30,000 tons of steel to the car company this fall, when the work of car building will begin. It is reported that the company has orders for steel cars amounting to about $2,000,000. Mr. A. R. Fraser is vice-president and treasurer, Mr. Gearhart is general manager, and Mr. Peter F. McCool is works manager.

The American Brake Shoe & Foundry Company announces the appointment of Mr. Joseph D. Gallagher as second vice-president, and Mr. Joseph B. Terbell as general sales manager. Mr. Gallagher was formerly president of the Lappin Brake Shoe Company, and Mr. Terbell was president of the Corning Brake Shoe Company.

The Grand Trunk Railway has recently contracted with the Safety Car Heating and Lighting Company for the equipping of 50 additional cars on their line with the Pintsch system of lighting. The Pintsch gas works at Moncton, N. B., which have been in the course of construction for the past two months, is now completed, and gas is being made there for use in the cars of the Intercolonial Railway.

Col. John T. Dickinson, who has heretofore represented the Consolidated Railway Electric Lighting and Equipment Company in Chicago, has been transferred to New York as general agent, with headquarters at the general offices of the company, 100 Broadway, and Mr. George W. Carhart has succeeded Colonel Dickinson as general agent of the company in Chicago and the West.

The Structural Steel Car Company's plant, which is now under construction at Canton, Ohio, is favorably located and is extensive, with provisions for future expansion. The principal buildings for the steel car plant are a main shop, 506 by 78 ft.; power house, 50 by 110 ft.; blacksmith shop, 50 by 75 ft., and office building, 50 by 40 ft., of two stories. The plant is on several lines of large railroads, which will make it convenient for repair work, for which the facilities are ample. The ground for the wooden car department is already staked off. The steel foundry will occupy 400 by 100 ft., with two lean-tos and other supplementary buildings. The officers of the company are: Ellwood C. Jackson, president; H. A. Cavnah, vice-president; A. S. Griffin, secretary and treasurer; J. R. Reed, general manager; W. H. Woodcock, general superintendent, and R. H. Hornbrook, engineer.

A train of cars 300 miles long represents the output in cars, to March, 1902, of the Pressed Steel Car Company of Pittsburgh. To be more exact, these car works had by March 27 turned out over 60,000 cars. The shops are pushed to their fullest extent, and in addition to the daily delivery of over 100 cars, a large number of trucks, bolsters, center plates and other pressed steel specialties for wooden and steel cars are manufactured. The steel cars built at Pittsburgh have practically revolutionized modern methods of freight transportation; the pressed steel car is much lighter in proportion to carrying capacity than the old style wooden cars used prior to 1897. In other words their tare weight is low and revenue load high, so that for any given gross tonnage less dead weight has to be hauled than was possible before the advent of the steel car.

William Imhauser, widely known as a manufacturer and inventor of watchman's time detectors, died at his home on Long Island, March 28. Mr. Imhauser was 77 years old, and was a native of Germany, where he introduced watchman's time detectors. He came to the United States in 1867 and started in business for himself as a manufacturer of time detectors in 1869. Later he obtained a number of patents on notable improvements in these instruments. Mr. Imhauser was the recipient of many medals of award from expositions for his work in this line, his time detectors receiving medals from the Centennial Exposition, the American Institute, the Cotton Exposition at Atlanta, in '81, the Exposition for Railway Appliances at Chicago, in '83, the Pan-American Exposition, last year, and many others. Mr. Imhauser was active in business until about five years ago, when his bad health caused him to retire. The business, which is known as E. Imhauser & Co., is conducted by his wife, Mrs. Elise Imhauser, and his son-in-law, George M. Still, and will be continued by them without change.